CONTROL OF DISEASES AND INSECT ENEMIES OF THE HOME VEGETABLE GARDEN

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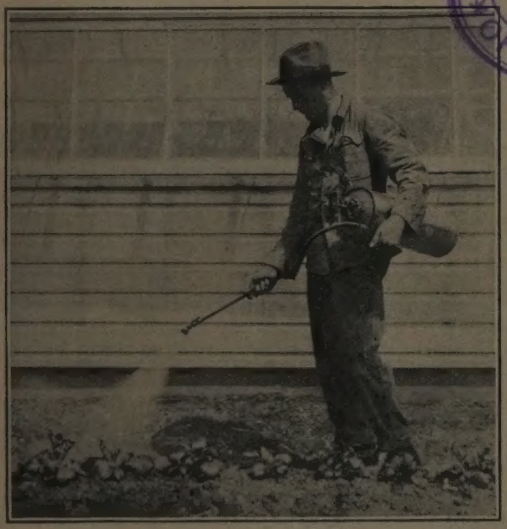

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UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
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and the
Bureau of Entomology
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Washington, D. C. November, 1917

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THIS bulletin contains directions for the control of the most common insects and diseases of the home vegetable garden.

Preventive measures are best. Rotate crops. Avoid introducing insects and diseases on plants obtained for setting out. Practice clean cultivation. Employ fertilizers to stimulate plant growth. Work on the principle that a vigorous growing garden will produce a crop in spite of injurious insects and diseases.

Become familiar with the insects and diseases known to occur in your district on the crops you are growing. Equip yourself in advance with all necessary remedies and the means of applying them. Remember that the timely application of a remedy acts as an insurance against loss.

Watch constantly for the first appearance of a disease or insect. Inspect the garden at least every other day. Determine what is causing injury and apply the proper treatment promptly. Use the combination treatments in case a complication of troubles is present. Repeat treatments as often as necessary, keeping in mind the influence of weather conditions as well as the life history of the insect or fungus causing the disease.

Use insecticides and fungicides in the proper dilution to accomplish the object without injuring the plants. Standard remedies are best. Test others experimentally before using them on a large scale.

Use the best sprayers. A thorough application is necessary for the best results. Adjust the sprayer so that all parts of the plant that are exposed to the air will be covered.

Work for cooperation in the neighborhood. One badly infected or infested garden may be the source of disease infection or insect infestation for several near-by gardens. Keep your own garden clean and it will be an object lesson for careless neighbors and will have a tendency to help clean up the neighborhood. This will make control easier and cheaper another year.

CONTROL OF DISEASES AND INSECT ENEMIES OF THE HOME VEGETABLE GARDEN.

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PLANT DISEASES AND INSECTS.

FROM the time the seeds of garden crops are put into the ground until the crops are harvested a succession of diseases and insect enemies may appear, each of which must be fought by the methods that experience has shown to work best in the particular case.

Diseases of plants are due to many causes. Plants suffer if the soil is not suited to them. It may be too rich or too poor or too heavy or too light, or it may contain too much or too little water. It may lack lime and humus. Some vegetables, such as spinach and cauliflower, thrive in cool weather and do poorly in midsummer, while others, like tomatoes and Lima beans, are hot-weather plants. Excessive heat produces wilting or tipburn. Too much water in the soil keeps from the roots the air they need and causes a sickly, yellow growth. Fertilizers used carelessly or in excess may burn the leaves, injure the roots, or prevent seed from germinating.

It always is important to have the soil deeply plowed or spaded and made loose and light with plenty of well-rotted manure or compost and to keep the ground cultivated so that the surface will not become hard or weedy. Use the best seed to be had and sow it liberally to get a good stand, but thin out the plants, as overcrowded plants are in much greater danger of becoming diseased than those that receive plenty of air and sunshine.

The diseases which cause most loss are due to fungi and bacteria and will be referred to often in the bulletin. Fungi and bacteria are plants, though usually exceedingly small. The disease-producing forms live on or in our vegetables and fruits, feeding on them and causing the various blights, rots, and spots of which we complain.

Fungi and bacteria grow and multiply rapidly when conditions suit them. Instead of seeds they form spores, which are minute bodies produced in great numbers, to be spread by wind, water, or other agencies, and, like seeds, these spores may germinate, grow into a plant or fruit, and start a new center of disease.

The weather has an important influence on the development of fungous diseases, moisture and warmth being necessary.

True insects are small creatures which in the adult stage have rather hard bodies divided into three portions, head, thorax (chest), and abdomen (belly). They have a single pair of antennæ, or "feelers," normally three pairs of legs, and usually one or two pairs of wings. Among injurious forms of true insects are beetles, butterflies, moths, sawflies, ants, flies, grasshoppers, plant-bugs, thrips, and plant-lice.

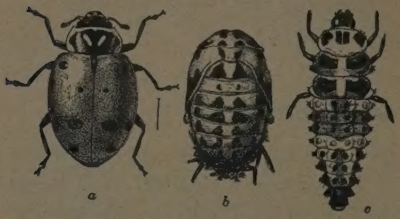

FIG. 1.—The convergent ladybird (*Hippodamia convergens*), an enemy of garden insects: *a*, Adult; *b*, pupa; *c*, larva. Enlarged.

Other small creatures in a general way are popularly classified as insects, such as sowbugs, red spiders, mites, and thousand-legged "worms," or millipedes.

Insects are classified into (1) chewing or biting forms, which devour leaves and other portions of plants; and (2) sucking forms, which injure and destroy plants by draining their vital life juices. For the first class, arsenicals are the best remedies; for the second class, contact poisons are used.

Gardeners should learn to know the insects which are useful in destroying injurious insects. Prominent among these is the convergent ladybird (fig. 1). It destroys not only all forms of garden plant-lice but the eggs of various insects, such as the Colorado potato beetle. Other beneficial insects are wasps, ichneumon and chalcis flies (minute, wasplike insects), ground beetles, soldier bugs, syrphus flies, tachina flies, and lace-wing flies. Were it not for the natural enemies of the potato beetle and of cabbage worms, army worms, and similar pests, all vegetable crops probably would be failures.

PREVENTION OF DISEASES AND INSECT INFESTATION.

The gardener who starts with a clean soil may do much to keep insects and diseases out, and thus save the trouble and cost of applying sprays. Prevention is better than cure, especially in the home garden, which usually must be planted on the same ground year after year.

Some of the worst garden troubles are brought in on the roots of plants and remain in the soil to attack the next crop. So in buying plants of any kind one should be sure that they are healthy and free from insects. The roots should be clean and fibrous, not swollen or knotted. Southern gardeners in particular should be on the watch against root-knot (fig. 2). Cabbage and cauliflower plants should be inspected for clubroot (fig. 3), and sweet-potato plants for black-rot (fig. 4). Irish potatoes should be treated for scab before planting.

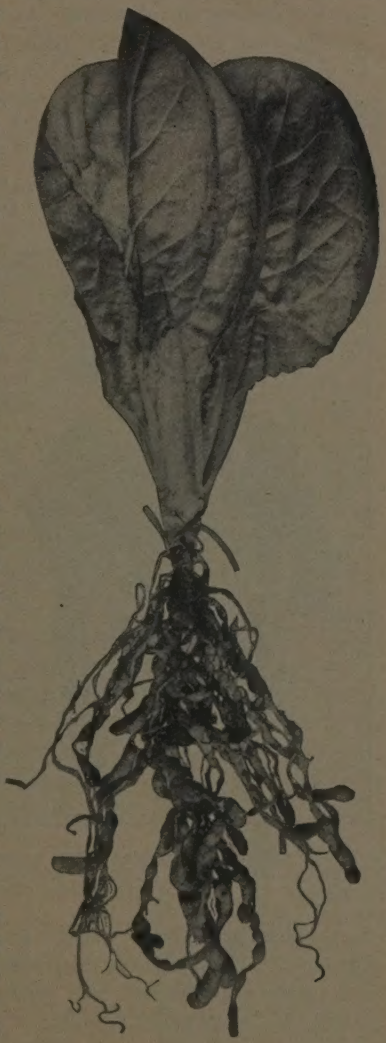

FIG. 2.—Root-knot on lettuce. Similar galls are formed by this pest on the roots of nearly all vegetables.

CONTROL INSECTS THAT SPREAD PLANT DISEASES.

Many insects not only attack the crops directly but also carry plant diseases. Thus, the striped cucumber beetle spreads the wilt of cucumbers, squashes, melons, and related plants; plant-lice carry the cucumber mosaic; the potato flea-beetle, the bacterial wilt; and various other insects occasionally carry spores from diseased to healthy plants.

AVOID WOUNDING PLANTS.

In cultivating or working around plants, avoid wounding or breaking them. In pruning, make a clean, close cut. In harvesting fruits and vegetables that are to be stored, handle with the greatest care to avoid bruising, as decay most frequently begins where the natural protective covering is broken. Certain insects, such as the potato tuber moth, also gain access at such points.

SANITATION.

Neatness, cleanliness, and order in the garden help in the fight against insects and diseases. As a general rule, the residue of the garden, such as cornstalks, potato tops, etc., are to be turned under to improve the soil. Do this promptly, so that insects and disease spores may not be harbored by the rubbish. In some cases, which will be pointed out later, diseased vegetable remains should be taken out of the garden and burned. Weeds in the garden and around it harbor both insects and diseases, particularly if the weeds are related to the cultivated plants. Plant-lice, red spiders, and other insects invade the garden from neighboring weed borders. Cabbage pests live on wild mustard, shepherd's-purse, and related weeds. Just as soon as any crop is gathered, spade up the ground, bury the old remains deeply, and plant something else. Except in the extreme North, rye or oats can be sown to give winter cover.

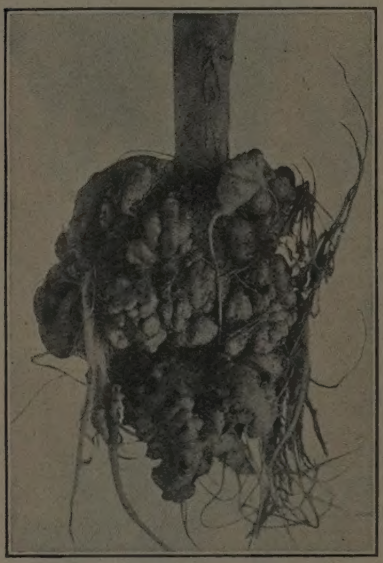

FIG. 3.—Clubroot on cabbage. This attacks turnips and related plants in the same manner.

CROP ROTATION.

Farmers have found that by rotating their crops they reduce the injury from plant diseases and insects and also increase the fertility of the soil. This principle applies to the home garden, where, if possible, it will be better to make a new plan each year, placing each vegetable where some other grew the year before—peas on the old tomato ground, beets and carrots after the corn, etc. The details of this rotation must vary in each case according to the climate, soil, and vegetables grown and the diseases and insects to be guarded against.

FORMULAS FOR FUNGICIDES AND INSECTICIDES.

BORDEAUX MIXTURE.

Bordeaux mixture is used for the control of fungous diseases of many vegetables and fruits and as a deterrent of flea-beetle attack. It can be purchased in convenient package form from seed dealers or

prepared at home from bluestone (copper sulphate), which costs 10 to 25 cents per pound, and fresh stone or lump lime (quicklime).

Bluestone	ounces	4	or	Bluestone	pounds	4
Quicklime	do	4		Quicklime	do	4
Water	quarts	12		Water	gallons	50

Dissolve the bluestone in a wooden or earthenware vessel, using hot water. Dilute with half the water. Do not use tin or other metal containers, as they would be spoiled. Slake the lime by adding water, a little at a time. When reduced to a milky fluid, dilute with the rest of the water and strain through doubled cheesecloth or a brass wire strainer of 18 meshes per inch and pour into it the bluestone solution. Stir well and apply at once. This is best when prepared fresh for each using.

Usually it is difficult to get fresh lime at short notice, as needed. To save trouble, the owner of a small garden may weigh out at one time several 4-ounce lots of lime, perhaps as many as he expects to use during the summer, slake them in old glass jars, cover with water, and set them away. The lime will remain in good condition as long as it does not become dry, and each jar is sufficient to use in making a pailful of Bordeaux mixture, or one filling of the average small sprayer. Those who have to spray large fields or orchards should consult Farmers' Bulletin 243.

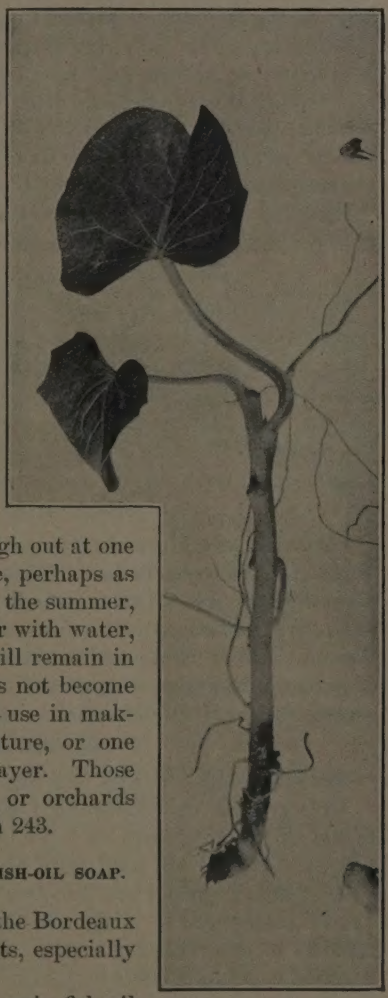

FIG. 4.—Black-rot on sweet potato. Plants showing blackened discolorations on the underground parts should be discarded.

BORDEAUX MIXTURE WITH RESIN FISH-OIL SOAP.

Resin fish-oil soap is added to the Bordeaux mixture to make it stick to plants, especially those with smooth leaves.

Add to the foregoing formula resin fish-oil soap, two-thirds of an ounce to 1 ounce per gallon. It is necessary to add water to the soap a few drops at a time, stirring well until

the sticky soap is dissolved. This soap can be purchased of most dealers in garden supplies.

CARBOLIC-ACID EMULSION.

Carbolic-acid emulsion is a good remedy for certain root feeders, such as root-maggots, which are injurious to onions, cabbages, turnips, beans, and similar plants, to protect against the fly or adult depositing eggs. Its value for other purposes is somewhat limited. It is prepared by mixing half a pound of soap in half a gallon of water and 1 quart of crude carbolic acid, or phenol, and is then diluted with about 25 parts of water. It should be applied a day or two after the plants are up, and, in the case of transplanted crops, a day after they are transplanted, and should be repeated if necessary.

Carbolic acid acts as a repellent and is a contact and stomach poison. It is corrosive and should be handled with care.

CORROSIVE SUBLIMATE (MERCURIC CHLORID).

Mercuric chlorid (corrosive sublimate) is used for treating seed potatoes and cabbage seed for diseases. It may be purchased at drug stores in the form of tablets costing about 25 cents for 24. Dissolve two large tablets in a quart of water to make a 1 to 1,000 solution. For larger quantities use 2½ ounces to 15 gallons of water. *Corrosive sublimate is a deadly poison.* It attacks metals and therefore must be used only in a wooden, glass, or earthenware vessel.

FORMALDEHYDE (FORMALIN).

Formaldehyde (formalin) is used for treating seed potatoes, seeds, and soil, to prevent diseases. This is a clear solution of 40 per cent formaldehyde gas in water, which retails at about 50 cents per pint. It is very irritating to the eyes and to cuts, but not poisonous. It does not attack metals. Use 1 teaspoonful to a teacupful of water, 1 ounce to 2 gallons of water, or 1 pint or pound to 30 gallons of water (for potatoes and onions). It is not an insecticide.

KEROSENE EMULSION.

Kerosene-soap emulsion is a remedy for most sucking insects.

This is made by combining 1 gallon of kerosene and one-fourth pound of laundry soap, or 1 pound of whale-oil (fish-oil) or other soap, or 1 pint of soft soap, with half a gallon of water. The laundry soap, if dry, is shaved and dissolved in boiling water and then poured (away from the fire) while still boiling hot into the kerosene. The mixture is then churned rapidly 8 or 10 minutes, the liquid being pumped back upon itself by means of a sprayer with a nozzle throwing a strong, solid stream. At the end of this time the mixture has become a thick cream—the stock emulsion. In the preparation of the emulsion a sprayer is a necessity, since if it is not made as directed a perfect emulsion will not be formed. If properly prepared, this stock emulsion will keep through a season and is to be diluted only as

needed for use. For most species of sucking insects 1 part of the stock emulsion should be mixed with 15 parts of water. It is then applied with a fine nozzle in the form of a mist spray or like a dense fog, and is sprayed only long enough to cover the plants.

If the spray is not applied properly it may drip off the leaves, causing the ground beneath to become soaked. As a result delicate plants when exposed to direct sunlight may be injured or killed. For this reason nicotine sulphate is preferable.

LEAD ARSENATE.

Paris green, formerly much recommended for biting and chewing insects, such as the Colorado potato beetle, cucumber beetles, cabbage worms, and tomato hornworms, because it was known to most farmers and is for sale at drug stores, is being superseded to a considerable degree by other arsenicals, of which the most important is arsenate of lead, or lead arsenate.

The present high cost of all copper compounds has resulted in a similar high price for Paris green. Although arsenate of lead has also risen in price it is less costly and is preferable for the following reasons: (1) It serves the same purpose as Paris green against external leaf-eating insects and certain other chewing insects; (2) it is applied in the same manner; (3) it is less harmful to growing plants, being less likely to burn delicate foliage; (4) it adheres better to the foliage; (5) it is less troublesome to prepare; and (6) the white coating which it leaves on the plants after spraying shows which plants have not been reached by the treatment.

Lead arsenate, however, does not kill insects as quickly as Paris green, although the fatal dose is absorbed nearly as soon.

Arsenate of lead is sold in both powder and paste forms. At the rate of 2 pounds of powder or 4 pounds of paste to 50 gallons of water or Bordeaux-mixture solution it will destroy cabbage worms and most other caterpillars, the "slugs" and adults of the Colorado potato beetle, cucumber beetles, and most other insects of this nature.

In small gardens two-thirds of an ounce of the powder form, or 10 level teaspoonfuls, to 1 gallon of water is used.

Generally, the adhesiveness of lead arsenate is enhanced by the addition of a "sticker" of about the same amount by weight of resin fish-oil or other soft or dissolved soap as of the arsenical used. This must be used in the case of cabbage and similar crops, since otherwise the waxy bloom of the foliage repels the liquid, causing it to gather in large drops, and a thorough distribution, on which the success of the treatment depends, is not secured. If properly applied, the leaves should show a thin white coating of the poison for a long time.

The number of sprayings to be applied will depend on the insect concerned in the injury and on local and seasonal conditions. Some-

times a single application at the proper time will suffice, although two or three are required for the cabbage worm, potato beetle, and certain other insects which produce more than one generation annually.

LIME.

Lime is used to control cabbage clubroot. It neutralizes soil acidity and therefore tends to increase scab on potatoes. It acts at the same time to a limited extent as a deterrent against certain insects which may be in or on the soil, such as maggots and grubs, and is a good remedy for slugs. Air-slaked or hydrated lime is the best form to use.

GAS LIME.

Gas lime is particularly valuable against certain underground insects. It may be placed between the rows of some crops, but as a general rule should be used after the crop is off. It is a refuse or by-product of gas-manufacturing plants and is simply lime through which the illuminating product has passed in the primary stage of purification. It may be obtained frequently for the mere cost of hauling. It is highly impregnated with gas and tarry substances when perfectly fresh, giving out a strong odor for several days after being applied. It should be remembered that it will kill plant life as well as insects, and it is best to use this on a small scale before employing it extensively.

LIME-SULPHUR.

Lime-sulphur is a valuable spray for fruit trees, but not suited for use on vegetables. Experiments have shown that potatoes are injured rather than benefited by it.

NICOTINE SULPHATE.

For small garden plats 1 teaspoonful of nicotine sulphate should be used to 1 gallon of water, to which a 1-inch cube of hard soap should be added and thoroughly mixed. If a larger quantity is desired, use 1 fluid ounce to 8 gallons of water, with the addition of one-half pound of soap. Full directions are given on the covers of the packages, and instructions accompany them.

For large forms, like the pea aphis, the nicotine should be used slightly stronger, and for small kinds, like the spinach aphis, it may be used considerably weaker.

The following nicotine-spray formula will be found the best for the average aphis or plant-louse on truck crops, as well as for thrips:

Nicotine sulphate (40 per cent)	pint	½
Soap (dissolved)	pounds	2
Water	gallons	50

This formula gives 1 part nicotine sulphate to 1,000 parts of water.

The quantity of soap required will vary with the quality of water, more soap being required in "hard" water; but on the average the

proportion specified in the formula will give satisfaction. An examination of a freshly sprayed vine will show whether there is sufficient soap in the mixture. If the spray draws together in drops and leaves part of the foliage dry, more soap should be added. Where possible, fish-oil soap should be used, but if it can not be procured, cheap laundry soaps will do. The composition of the cheap soaps is variable, and if too much soap is used, some injury may result to tender foliage.

In the use of nicotine sulphate the effective application of the spray is of the utmost importance, since it is primarily upon this that the success or failure of the treatment depends. If the liquid has stood for any length of time it should be agitated thoroughly before use. The insects themselves must receive a thorough coat of the spray or they will not be killed, and immediate inspection after spraying should show the foliage occupied by the insects to be completely wet.

Spraying should be done as early as possible, *always on the first appearance of the insect*, not only because it is good practice to keep the plants free from pests, but because more thorough work can be done on small plants.

SOAP PREPARATIONS.

Soaps of most kinds are of value in solution as washes and as sprays in the control of certain noxious insects. Both hard and soft soaps are employed, and so-called whale-oil soaps, usually manufactured from fish oil, are of great value and much used. Among these are cresol soap and resin fish-oil soap. Such soap is usually prepared by dissolving 1 pound in 4 to 10 gallons of water. On some hardy plants a solution of 1 pound of soap to 2 gallons of water can be used, but this strength is harmful to delicate plants and must be used with caution. The best strength for ordinary plants is about 1 pound in 6 to 10 gallons of water, applied as a spray. It is of most value against plant-lice, minute leaf-bugs, leafhoppers, and thrips, and against some forms of small soft-bodied and sensitive insects and their young. Soaps possess no particular advantage, however, over nicotine sulphate or kerosene-soap emulsion, but are easier to prepare than the latter.

Neutral soaps of the Castile type are much used on plants grown under glass and as a means of checking the ravages of plant-lice, thrips, red spiders, and some other forms of small insect pests. They are particularly valuable against many insects which obtain their food by suction.

HOMEMADE SOAP.

Homemade soap can be prepared by following the directions printed on cans of lye for household use. It will save considerable

expense, and those engaged in gardening can do this work at odd times or when the garden is wet with rain.

SULPHUR.

Sulphur is used for mildews. Use the finest flour sulphur obtainable. A special grade is made for dusting plants. Sulphur compounds are valuable for the red spider and for some other forms of mites, but they should be followed by syringing or spraying with neutral soap solutions or water.

MECHANICAL METHODS OF CONTROL.

For garden insects there are several control methods that do not require the use of insecticides, but too much must not be expected from them. Of these hand picking is useful for large, comparatively inactive insects such as the potato beetle, cutworms and other caterpillars, and the squash bug. Another method is jarring or beating insects from low plants into large pans of water on which a thin scum of kerosene is floating. The water prevents the insects from escaping, and the kerosene, being on the surface, kills the insects with which it comes in contact. Collecting nets are valuable for some pests; for example, the tarnished plant-bug. Brushing by different means is used to a considerable extent and consists in beating or brushing insects from the plants with pine boughs or similar brush. This method has proved of great value in combating the pea aphis. Covering with cloth is of use as a preventive for the striped cucumber beetle when the cucumbers are quite small, and for root-maggots. Trapping by different methods with old boards is useful for squash bugs and cutworms. Poisoned baits may be placed under such traps. Plowing, disking, and harrowing all can be done by hand and are of considerable service.

SPRAYING METHODS.

To be successful in the control of insects and diseases, spraying must be done promptly and thoroughly. Spraying with Bordeaux mixture should be done before rains rather than after, provided the spray has time to dry on the leaves. Where the advice on later pages is to "repeat spraying every 7 or 10 days," these intervals should depend on the weather. If it is rainy or muggy, with fogs or heavy dews, spray frequently to keep the foliage protected at all times. If dry, a longer time may be allowed.

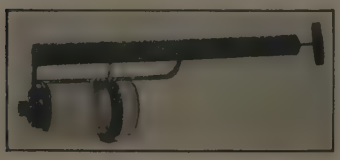

FIG. 5.—An atomizer sprayer.

The ideal spray is a fine mist, and the best work is done when the plant is thoroughly and evenly covered with fine drops. Stop spraying before the foliage is drenched.

The higher the pressure, the better the spray.

Clean all sprayers each time after using.

For delicate foliage, spray after this gets under shade. Hot sunlight is dangerous with many sprays, such as kerosene emulsion.

SPRAYING AND DUSTING APPLIANCES.

The materials recommended herein may be applied in various ways.

For the small garden an atomizer sprayer, such as is shown in figure 5, is good, but a better sprayer for gardens of small and medium size is illustrated in figure 6 and on the title-page. In the case of the atomizer sprayer it is an advantage to have the container for the liquid made of glass, as Bordeaux mixture and other materials attack tin and iron. These sprayers cost from 50 to 75 cents. A similar but more durable and effective sprayer made of brass costs $1.25.

Compressed-air sprayers may be had in galvanized steel at $3.50 to $5, and in brass at $6.50 to $12.50. Bucket sprayers such as the one shown in figure 7 range in price from $2.25 to $5. To do good work with them, however, two persons are required.

Really efficient sprayers are expensive, but if well cared for will last many years. Neighborhood cooperation may solve this problem. If a number of garden owners club together to purchase a sprayer, it is advised that a barrel pump on a hand cart be secured, or the bar-

FIG. 6.—Compressed-air sprayer.

row type shown in figure 8, which is a thoroughly effective outfit, capable of giving 120 pounds pressure. It will apply any liquid fungicide or insecticide to vegetables, shrubbery, or orchard trees. The cost is $25. It is often possible to secure the services of a local trucker or orchardist who has a sprayer, but no one should be deterred from protecting his garden when an atomizer may be purchased for 50 cents or even less.

The powders may be shaken from a muslin bag tied to a stick, or various forms of dusters, bellows (fig. 9), or blowers may be bought. Dry powders are best applied when the leaves are wet with dew.

GENERAL-CROP PESTS.

From the standpoint of their food plants, injurious insects may be grouped roughly into two classes: First, those which are choice feeders and ordinarily attack only a single crop, or crops of a single class, although when they are extremely abundant they may resort to other crops or weeds. Examples are the asparagus beetles and asparagus miner and the large tomato worms, which confine their feeding to plants of a single family. Second, those known as general feeders—insects which are not particular as to their food plants. Some of these devour nearly every form of vegetation that grows in the garden. These include cutworms and other caterpillars, several forms of leaf-beetles and flea-beetles, plant-lice, thrips, blister beetles, and others. When abundant, some of these pests do great damage, sweeping over large areas and ruining entire crops before they can be stopped.

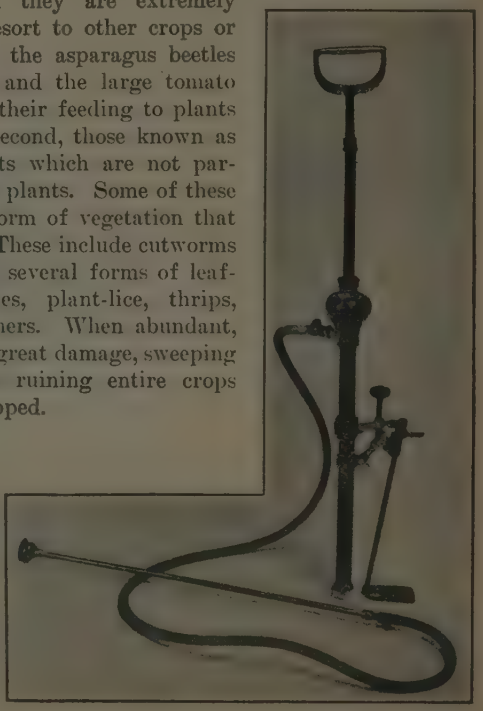

FIG. 7.—A bucket sprayer.

CUTWORMS.

Tomatoes, sweet potatoes, and other truck plants, particularly when started under glass, are likely to be injured by cutworms (fig. 10) when transplanted. These appear in great numbers in the spring and early

FIG. 8.—A barrow type of sprayer in use.

summer, and the injury is often complete before the gardener notices it. The chief injury is due to the severing of the stems of young plants at about the surface of the ground. One cutworm can destroy many plants in a single night by cutting off more than it can devour.

Control.—The best remedy is what is called "poisoned bait." For use in a small garden take 1 peck of dry bran, add 4 ounces of white arsenic or Paris green, and mix thoroughly with 2 gallons of water in which has been stirred half a gallon of sorghum or other cheap molasses.

For a large garden, use 1 bushel of bran to 1 pound of the arsenical mixed with 8 gallons of water containing half a gallon of molasses. This is enough for treating 4 or 5 acres of cultivated crops.

FIG. 9.—A powder bellows.

After the mash has stood for several hours, scatter it in lumps the size of a marble over the garden where the injury is beginning to appear and about the bases of the plants set out. Apply late in the day so as to place the poison about the plants before night, which is the time when cutworms are active. Apply a second or third time if necessary.

Arsenic and Paris green are deadly poisons. Handle them with great care.

It is advisable to keep young children, live stock, and chickens away from this bait.

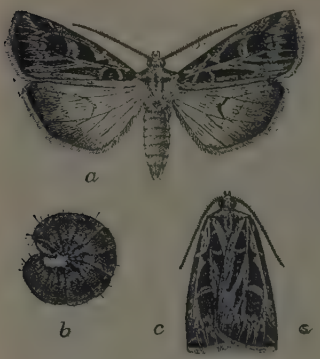

FIG. 10.—The dingy cutworm (*Feltia subgothica*): *a*, Moth, or adult, with wings expanded; *b*, larva, or worm, in curled-up position when feigning death; *c*, moth with wings folded. Somewhat enlarged.

In severe attacks by cutworms on low-growing plants, such as parsley, a lead-arsenate spray will answer in place of the bait.

Clean cultural methods and crop rotation are advisable, as are also deep fall plowing and disking, to prevent recurrences of cutworm attacks. Experienced growers become expert in detecting cutworms and remove them by hand. This often can be done with profit on small patches.

WHITE GRUBS.

When new land is used for planting vegetables, especially land that has been in sod or grown up with weeds, white grubs are almost certain to make their appearance, sometimes in large numbers, doing great damage to plants from the time they attain any growth until the fruit is ready for harvest. They feed chiefly on roots and attack especially potatoes, corn, and strawberries, but they are general feeders. White grubs, or "grub worms," are the larvæ or young of the brown May or June beetles, with which most persons are familiar. (Fig. 11.) The beetles occur in the North as late as August, while in the South they appear in April or earlier.

FIG. 11.—A white grub, or May beetle (*Lachnosterna arcuata*): *a*, Beetle; *b*, larva, or grub; *c*, pupa. Enlarged one-fourth.

Control.—Deep plowing is the most effective remedy for white grubs. Cross plowing and deep disking are sometimes necessary, and the ground should be disturbed often and kept clean of weeds so that the grubs can be eliminated.

Rotation of crops, avoiding the planting of potatoes, beets, sweet corn, and other crops on land which has been for some time in the same crops or in strawberries, grasses, or weeds is advisable. Fer-

tilizers, especially kainit, as a heavy top-dressing are of benefit. Gas lime is valuable. (See p. 10.) Hogs, if allowed the run of the newly plowed garden, or when the crop is off, will eat large numbers of grubs. Domestic fowls will pick up grubs on newly plowed land. See Farmers' Bulletin 543, "Common White Grubs."

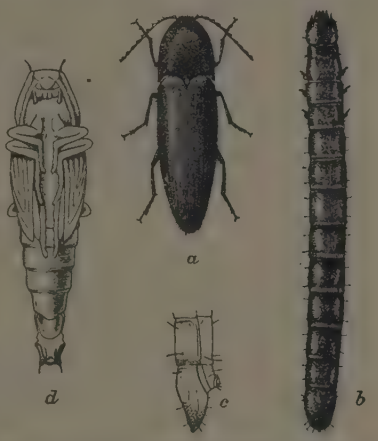

FIG. 12.—The common wireworm (*Melanotus communis*): *a*, Adult; *b*, larva; *c*, last segments of same; *d*, pupa. All enlarged.

WIREWORMS.

Wireworms, like white grubs, are common pests in the garden and are also general feeders. They are the offspring of snapping beetles, or "snap-bugs," and are of long oval form. (Fig. 12.) Their tastes are similar to those of the white grubs. They attack and often do great injury to potatoes and other plants bearing tubers, as well as to carrots, beets, sweet potatoes, and onions.

Control.—The remedies advised for white grubs apply also to wireworms, with due care in selecting land for planting and in fall plowing and crop rotation. Wireworms, however, are much more difficult to control than white grubs.

FIG. 13.—The ash-gray blister beetle (*Macrobasis unicolor*): Female beetle. Much enlarged.

BLISTER BEETLES.

Blister beetles (fig. 13) are common farm pests and are very destructive to vegetables, especially beans, peas, potatoes, and beets. They travel in the same manner as army worms and are sometimes called "army beetles" for this reason. They are hungry feeders and travel frequently in lines, eating everything in their path, chewing up apparently more than they need for food. They are slender in form, somewhat soft bodied, and colored variously. Some species are perfectly black, some are yellow with black stripes, others are of the same color with several light stripes, some are gray, and others are gray spotted with black. Blister beetles are particularly abundant in the Southwest, but occur practically everywhere. Different species appear at different times,

usually after the plants have made about one-third growth, and they continue until late in the season.

Control.—Lead arsenate applied at the very outset of attack is the best remedy. In some portions of the Southwest lines of men and boys go through fields driving beetles before them until they reach windrows of hay, straw, or other dry vegetable matter previously prepared along the leeward side of the field. The windrow is then fired and the beetles burned. Hand picking is somewhat dangerous, as the blister beetles are likely to form blisters on a delicate skin. It is, moreover, somewhat difficult to collect the beetles, as they are extremely active compared to the sluggish Colorado potato beetle.

GRASSHOPPERS.

Grasshoppers, while more important pests in fields of grain and forage, are often troublesome to vegetables in the dry regions of the Middle West.

Control.—Poisoned baits especially adapted to grasshoppers are generally used, of which the best formula is as follows:

Bran	pounds	25
White arsenic or Paris green	pound	1
Oranges or lemons	fruits	6
Cheap sirup or molasses	quarts	2
Water	gallons	3 or 4

This should be scattered thinly over infested ground or on plants attacked.

Where it is possible to turn turkeys into gardens without injury to the plants, they will make short work of the grasshoppers. When the fields are plowed, disked, or harrowed, this also destroys the grasshopper eggs. See Farmers' Bulletin 691, "Grasshoppers and Their Control on Sugar Beets and Truck Crops."

PLANT-LICE.

Practically all vegetables, especially cucumbers, cabbages, and peas, suffer considerable damage from attack by small, soft-bodied insects commonly called "lice" or "aphis," but better known as plant-lice. (See fig. 39, p. 35, and fig. 50, p. 45.) These work for the most part on the lower sides of the leaves, which become curled or otherwise destroyed by loss of their vital juices. They give off a sweet mixture called honeydew, which attracts ants, flies, and other insects. Plant-lice increase with great rapidity by the female giving birth to living young. The different kinds vary in color from light to dark green or nearly black, grayish, brown, yellow, and red. They have comparatively long legs and have feelers attached to the head. Some forms have two pairs of transparent or clear wings. They feed by sucking juices of the plants through a beak. Familiar examples are the melon aphis, pea aphis, and cabbage plant-lice.

Control.—If the plants are grown under glass, plant-lice may be killed by fumigation with a nicotine preparation. The form suitable for this work is paper soaked in nicotine which when lighted causes a smudge. Sprinkling plants with fine tobacco dust is of some value, especially if applied early in the morning when the dew is on. Under large vegetable garden conditions standard 40 per cent nicotine sulphate gives almost perfect results if properly diluted and applied. It may be used at the rate of 1 teaspoonful of sulphate to 1 gallon of water with a 1-inch cube of laundry soap. See "Nicotine sulphate" (p. 10).

ANTS.

Certain species of ants may be found afield from March to October, and often occur in greenhouses and coldframes attacking cabbage and related plants, eggplant, lettuce, beans, parsley, radishes, tomatoes, and peppers. They attack the roots, crown, and lower portions of the stem, and completely destroy young plants.

Control.—The best remedy is fumigating the nests with carbon disulphid by means of a machine oil can made of metal. Locate the nest and, if possible, the female, or queen. Inject about two or three teaspoonfuls of the liquid into the entrance to the nest, and if not effective soon repeat the dose a little stronger. Hot water will answer the purpose if the insects are not too abundant. Poisoned baits as for cutworms have been used with good effect. See "Cutworms" (p. 14). Careful watch should be kept for the appearance of these insects in lawns and elsewhere about the grounds and the nests destroyed. Consult Farmers' Bulletin 740 on "House Ants."

ONION THRIPS.

The onion thrips (fig. 14), incorrectly called "thrip," is microscopic in size and is often called the onion louse. It causes an injury somewhat generally known as white blast, white blight, and silver top. It also causes scullions, or thick necks—poorly developed and unmarketable bulbs. This species frequently ruins entire fields of onions. Besides the truck crops mentioned this thrips attacks cauliflower, cabbages, cucumbers, melons, pumpkins, squashes, parsley, tomatoes, kale, turnips, and seed beets. It is what is known as a general feeder, and it would be easier to mention plants which it does not attack than to list those which it uses as food.

Control.—Nicotine sulphate, as advised on pages 10 and 11, is used with success.

TARNISHED PLANT-BUG.

Nearly all vegetables are attacked by the tarnished plant-bug (fig. 15), a small leaf-bug measuring about one-fifth of an inch in length when mature. There are five distinct stages, called "nymphs," from

the time the egg is laid until the adult or winged form appears. This species is injurious to cabbages, turnips, potatoes, and cucumbers, and injury generally is done by the adults piercing and sucking the

FIG. 14.—The onion thrips (*Thrips tabaci*): Adult. Highly magnified.

juices from the plants and later attacking fruits and shoots. It is the cause of "buttoning," and is credited with carrying some forms of blight on plants. Were it not that this insect feeds on so great a variety of plants, thus distributing its attack, it would be a serious pest indeed.

FIG. 15.—The tarnished plant-bug (*Lygus pratensis*): Adult bug at left; last stage of nymph at right. Nearly four times natural size.

Control.—This plant-bug, when it occurs in great numbers, can not be kept within bounds by any single remedy. The great activity of the pest makes it particularly difficult to control. The best remedies are nicotine sulphate, kerosene-soap emulsion, and fish-oil soap. As in the case of plant-lice, insecticides must be applied in the morning before the insects have become thoroughly active and while dew is on the plants. In the small garden, sweeping all the plants, grasses, and weeds with an insect-collecting net will accomplish much toward keeping the pest in subjection.

RED SPIDER.

Practically all vegetables are subject to attack by the red spider (fig. 16). It is not a true spider but a mite, the latter name being indicative of its minute size. It is well distributed throughout the country. Among vegetables and truck crops most attacked are beans of all kinds, cowpeas, eggplant, cucumbers, tomatoes, melons, squashes, strawberries, raspberries, beets, and celery. It is also a greenhouse pest and does great damage to cucumbers and tomatoes, as well as to ornamental plants grown under glass. It is a general feeder in the broadest sense, infesting the foliage of shade and fruit trees and some field crops. It is often present on the under surface of leaves like beans without being suspected. This mite injures plants by sucking the juices, and when plants are neglected their vitality is slowly reduced by loss of sap, and in time all of the plant's functions are deranged. In case of severe attack, millions of red spiders can be found on the foliage, and the webs which the insect spins from plant to plant can be easily seen, with the mites themselves passing rapidly over them and congregating in swarms. Sometimes the plants look as though stricken by fire.

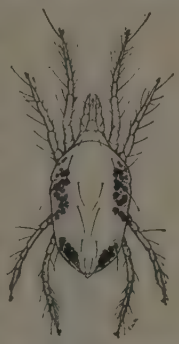

FIG. 16.—The female red spider (*Tetranychus telarius*). Highly magnified. (McGregor and McDonough.)

Control.—The remedies are spraying with soap solutions, kerosene-soap emulsion, and sulphur preparations. Flowers of sulphur mixed with water at the rate of 1 ounce to 1 gallon sprayed over infested plants is of great benefit. Unless remedial measures are adopted early and applied as often as necessity demands, red spiders are almost certain to do great harm to delicate plants, since if the plants become thoroughly infested they seldom survive. Frequent spraying with soap and water will often keep the pests in check, especially in greenhouses.

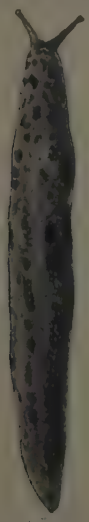

FIG. 17.—The imported garden slug (*Limax maximus*).

SLUGS AND SNAILS.

Much harm is done by slugs (fig. 17), little animals sometimes classified as insects, but really mollusks. They are not provided with shells, while snails are shell bearers. The latter are also sometimes troublesome, but their injury is limited. Attack is most severe on delicate seedlings grown in hotbeds, and in coldframes. Delicate garden vegetables of nearly all kinds also are

injured by them in the open, attack beginning when the plants are near the ground and even after the crop is ripening. Potatoes are bored into, and celery is often badly injured during the bleaching process.

Control.—The best remedy is a preventive and consists of lime in any form, quicklime being the most useful, sprinkled over the plants and scattered about the haunts of the slugs, which means all about the garden, buildings, outhouses, and fences. When the lime comes into contact with the slug, the latter secretes slime copiously and in time this completely exhausts the animal and it dies.

Other remedies are soot, dust, sifted wood ashes, and kainit. By scattering a line of any of these substances around a garden, cold-frame, or other inclosure, it will serve to keep the slugs away. To avoid slugs it is desirable to remove all rotten wood and old structures, and to keep the entire garden and yard free from rubbish of all kinds.

FIG. 18.—A common injurious springtail (*Achorutes armatum*). Much enlarged. (Popenoe.)

SPRINGTAILS.

Springtails (fig. 18) are minute, dark-colored, soft-bodied insects which hop like fleas. They have the same habit as flea-beetles of pitting the first-appearing leaves of all kinds of seedlings, which causes much disfigurement and reduces the yield of the crop.

Control.—The control is the same as for flea-beetles—Bordeaux mixture combined with lead arsenate or Paris green.

GENERAL-CROP DISEASES.

While most plant diseases attack only one crop or a group of related plants, there are some troubles which may occur on almost any of the garden vegetables, as a rule on the underground parts. These are Rhizoctonia, root-knot, and damping-off.

RHIZOCTONIA.

We might find a shorter name for this fungus, but more people know it and its effects by this term than as stem-blight, root-rot, scurf, or rosette. Among the plants attacked are potatoes, beets, beans, celery, lettuce, and carnations.

Dark cankers or dead spots are produced on the stem or roots (fig. 19), which may decay and weaken or kill the plant.

It is difficult to prevent or to control. Keep the soil in good tilth and the plants under the most favorable growing conditions possible.

ROOT-KNOT.

Southern gardens suffer greatly from the eelworm, gallworm, or nematode, which causes irregular swellings or galls on the roots of nearly all vegetables. (See fig. 2, p. 5.) It is most troublesome in sandy soils. Do not confuse this with the beneficial nodules on beans and other legumes or with the clubroot of the cabbage family.

A garden infested with root-knot may produce winter crops, as the eelworms are inactive in cold weather, but for summer crops a new location must be chosen. See Farmers' Bulletin 648.

FIG. 19.—Rhizoctonia on potato, causing dark, dead areas on the underground parts.

DAMPING-OFF.

Home gardeners who plant seed early in frames or in boxes in the house frequently lose the young plants shortly after they have germinated. The seedlings shrivel or decay at the soil line, collapse, and fall over. This is damping-off and is due to a fungus in the soil which attacks little plants that have been overwatered or kept too warm.

To prevent damping-off give light and ventilation, but avoid cold drafts. Water in the morning, so the soil will dry before night. Where a spot of damping-off has appeared, take out the affected plants, give more light and air, and sprinkle warm sand on the surface.

Sterilizing the soil of seed boxes will help to avoid the trouble. This can be done with small quantities by heating thoroughly in an oven soil which is moist, yet dry enough to crumble in the fingers.

The pressure cookers or steam sterilizers used for canning purposes are excellent for sterilizing soil.

PRINCIPAL GARDEN CROPS AND THE INSECTS AND DISEASES THAT ATTACK THEM.

ASPARAGUS.

ASPARAGUS BEETLES.

Two small beetles, one blue-black with yellow and dark-blue wing covers, the other red with black spots on the wing covers, the former known as the common, or blue, asparagus beetle (figs. 20–21), and the latter as the 12-spotted,[1] or red, asparagus beetle, do much injury to asparagus over the eastern United States. Attack begins with the first-appearing tips and continues until cold weather. The former eats the foliage both as a beetle and as a larva, or "slug." The latter's attack is confined to the beetle, the slug feeding inside the growing berry.

FIG. 20.—Spray of asparagus, with common, or blue, asparagus beetle (*Crioceris asparagi*) in its different stages; asparagus tip at right, showing eggs and injury. Somewhat reduced.

Control.—The best remedy is lead arsenate, sprayed, as for the Colorado potato beetle, from both sides of a plant, as the beetles are active and the foliage is difficult to reach, so as to leave a coating of poison. The tips for market should be cut as early and as promptly as possible in order to prevent injury. Dust the plants of larger growth, including volunteer plants, with fresh air-slaked lime while the dew is on. This destroys all slugs when it comes in contact with them. The slugs also may be killed in hot weather by brushing them from the plants with a switch so that they drop to the bare ground. They are delicate and crawl slowly, so that few are able to return to the plants, most of them dying from exposure to the heated earth. Since the red species develops in the berry, the slugs can not be reached by a spray. Collect the berries and promptly destroy them with the contained slugs. Consult Farmers' Bulletin 837.

ASPARAGUS MINER.

The maggot of a minute black fly, the asparagus miner, also does considerable injury, but it is not so well known as the beetles because of its small size.

[1] *Crioceris duodecimpunctata* L.

Control.—It may be controlled to a considerable extent by using nicotine sulphate. The last generation can be killed by pulling and

FIG. 21.—Common asparagus beetle: *a*, Beetle; *b*, egg; *c*, newly hatched larva; *d*, full-grown larva; *e*, pupa. Much enlarged.

promptly burning old infested stalks as soon as attack is noticed. Late in the fall, instead of cutting off the tops, as is the usual custom, pull them and burn them promptly. The rust-resistant plants mentioned below are also somewhat resistant to the miner.

ASPARAGUS RUST.

To control asparagus rust (fig. 22), plant the resistant varieties Reading Giant, Argenteuil, or Palmetto. Spraying with Bordeaux mixture is not recommended.

FIG. 22.—Asparagus rust.

BEANS.

ANTHRACNOSE.

Bean anthracnose is caused by a fungus which attacks the stems, leaves, pods, and seeds of the plants. On the stems and leaf veins it causes elongated, sunken, dark-red cankers, sometimes killing young plants and often producing deformed and yellowed leaves. Rounded or irregular sunken spots with a slightly raised rim are produced on the pods. (Fig. 23.) The spots usually have pink centers surrounded by a darker reddish border. In severe cases the pods may be entirely covered by the sores and produce no

seed. In other cases the fungus penetrates the pods and enters the seed, causing dark, sunken specks or spots. In these diseased seeds as well as in the refuse from diseased plants the fungus is propagated from season to season.

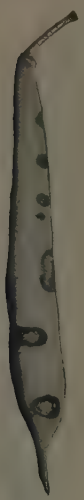

FIG. 23.—Bean anthracnose.

Control.—It has been demonstrated conclusively that anthracnose can be avoided by a careful system of seed selection. Save seed from perfectly healthy pods, selected with great care for entire absence of spotting. Carefully keep them away from diseased pods, shell by hand to avoid reinfection, and plant on clean land. Pull and burn any plants showing disease.

In the absence of such disease-free seed (1) secure for planting seed having the least possible amount of disease, as shown by actual examination; (2) all seed should be hand picked, and no seed showing the slightest discoloration should be planted; (3) practice crop rotation, and never plant beans on land where there is any refuse of last year's crop; (4) do not cultivate or walk through the bean field or pick beans while wet with dew or rain. If the disease is present, it is then easily spread from one part of the field to another.

FIG. 24.—Bean blight on leaf and pod.

BEAN BLIGHT.

Bean blight differs from anthracnose in several ways. It is caused by a bacterial organism. On the leaves it produces irregular, diseased areas which at first have a water-soaked appearance, but later dry out and become brown and brittle. (Fig. 24.) On the pods the disease starts as slightly raised and watery pustules, which later enlarge and become of irregular shape and amber in color. Infected seeds show yellow diseased blotches or are entirely yellowed and shriveled.

The bean blight is more difficult to control than anthracnose, but the same methods will give the best results at present available.

DOWNY MILDEW.

Lima beans are sometimes attacked by downy mildew, which covers the pods with a thick, felty, white growth. (Fig. 25.) If taken in time this disease can be controlled by thorough spraying with Bordeaux mixture. Apply when the disease appears and repeat at 10-day intervals as needed. Burn diseased pods.

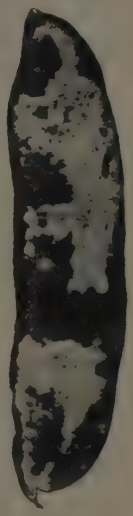

FIG. 25.—Downy mildew of Lima bean.

WEEVILS.

The principal insect enemies of beans are several species of bean weevils. The cowpea weevil also attacks beans when cowpeas are not available. Attack begins in the field from eggs deposited in a joint in the pod or opening through which the egg is thrust; the larva, or grub, develops within, and soon after the beans are harvested the weevils begin to develop, according to the temperature. A second generation of the common bean weevil (fig. 26) may be sufficient to destroy a crop of beans for either human consumption or seed. Several generations may be produced in a year.

The bean weevils vary in color. The common bean weevil is dull gray with reddish legs. None of these insects is much more than one-eighth of an inch long, and some are shorter.

Control.—Bean weevils can not be controlled in the field. They breed continuously in dried seed, and it is therefore advisable to harvest the crop and as soon as dry to fumigate with carbon disulphid. See Farmers' Bulletin 799, "Carbon Disulphid as an Insecticide."

FIG. 26.—The common bean weevil (*Bruchus obtectus*): *a*, Beetle; *b*, larva, or grub; *c*, pupa. Greatly enlarged.

BEAN FLY, OR SEED-CORN MAGGOT.

The seed-corn maggot, also called the bean fly (fig. 57, p. 52), an insect of about the size and appearance of the house fly, does great injury to early-planted beans, peas, and similar crops, and is frequently the cause of the failure of such plants to develop. The maggot scrapes or tunnels the seeds, sprouts, and stems of plants, both under ground and in the stalks above, decay soon sets in, and the plants die. Entire plantings are frequently destroyed.

FIG. 27.—The bean ladybird (*Epilachna corrupta*): *a*, Larva; *b*, beetle; *c*, pupa; *d*, egg mass. About three times natural size.

Control.—Much injury can be prevented by using mineral fertilizers, since soil containing much humus or mold or treated with barnyard manure is most subject to attack. Hand picking, although laborious, is effective, and can be used in a small garden. The standard remedy is carbolic-acid emulsion (see p. 8).

BEAN LADYBIRD.

The bean ladybird (fig. 27) is very injurious from Colorado southward to Mexico. It is the worst enemy to the bean crop of that region, and its work is compared to that of the Colorado potato beetle. Both grubs and beetles devour all portions of the plants—leaves, flowers, and green pods.

Control.—Use remedies advised for the Colorado potato beetle (p. 56). A spray strong enough to kill the beetles is apt to injure the foliage. Do not plant beans two years in succession in the same region.

BEAN LEAF-BEETLE.

The bean leaf-beetle (fig. 28) does much injury in the Eastern States and from Ohio southward to Louisiana. The beetles eat large round holes in growing leaves and feed also on related wild plants, such as beggarweed or tickseed. The grubs feed on the roots and main stem just below the surface, their habits being much the same as those of the better known cucumber beetles.

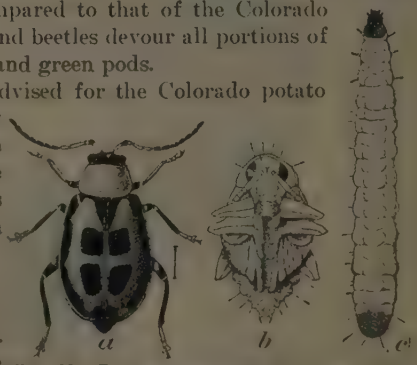

FIG. 28.—The bean leaf-beetle (*Cerotoma trifurcata*): *a*, Adult beetle; *b*, pupa; *c*, larva, or grub. Greatly enlarged.

Control.—Lead arsenate is the best remedy for this species. On young beans it must be applied at half strength to avoid burning the plants.

BEAN APHIS.

The bean aphis, a minute blackish plant-louse and a widely distributed pest, does injury throughout the country, being especially troublesome in California, working on the early plants.

Control.—Nicotine sulphate is the best remedy, applied as soon as possible and repeated as found necessary.

BLISTER BEETLES.

Beans and related plants are especially favored by blister beetles, and it is a common sight to see different forms travel from beets to beans or potatoes. See "Blister beetles" (p. 17).

BEETS.

BEET FLEA-BEETLE.

The beet flea-beetle (fig. 29), also known as the spinach flea-beetle, is particularly injurious to table beets, attacking them as soon as they are above ground. The young, or larvæ, develop on chickweed and lamb's-quarters, and a second brood is soon produced to attack the beets. The young frequently develop in such numbers as literally to "clean out" entire rows of beets before they are even noticed by the gardener. They even work down and bore into the crown of the plants.

FIG. 29.—The beet, or spinach, flea-beetle (*Disonycha xanthomelaena*): *a*, Beetle; *b*, pupa; *c*, full-grown larva. Five times natural size.

Control.—As this species is rather large for a flea-beetle, it can be controlled readily by arsenate of lead applied on the first appearance of the pest and renewed as often as needed. Since chickweed and lamb's-quarters are the natural food plants, they should be kept down in the early spring, not only on account of this insect but because of cutworms which develop on the same plants.

BLISTER BEETLES.

Blister beetles are almost as injurious to beets as to potatoes and devour the plants in the same way. For control, see "Blister beetles" (p. 17).

BEET ARMY WORM.

The beet army worm (fig. 30) is more injurious to beets than to other plants; hence the name. When numerous it is found also on potatoes, peas, onions, and other vegetables and grasses. It is a western form and capable of doing much damage.

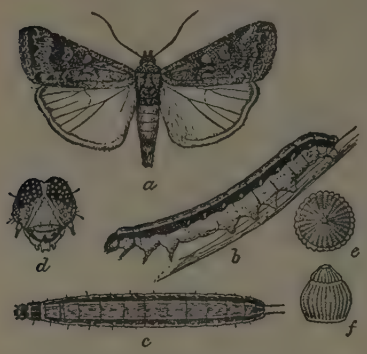

FIG. 30.—The beet army worm (*Caradrina exigua*): *a*, Moth; *b*, larva, side view; *c*, larva, dorsal view; *d*, head of larva; *e*, egg, viewed from above; *f*, egg, from side. All enlarged.

Control.—When occurring in moderate numbers this insect can be held in control by lead arsenate; when unusually abundant, remedies used for the true army worm are necessary. (See Farmers' Bulletin 835, pp. 9–11.)

BEET WEBWORM.

Several forms of webworms attack beets by eating the leaves, which become webbed together in the growing plants. The most injurious species is illustrated in figures 31 and 32.

Control.—Arsenate of lead spray. Gardens should be kept free from such weeds as pigweed and lamb's-quarters, since these encourage webworms and permit their spread.

FIG. 31.—The sugar-beet webworm (*Loxostege sticticalis*): Moth. Twice natural size (Howard and Riley).

FIG. 32.—The sugar-beet webworm (*Loxostege sticticalis*): Full-grown larva. Enlarged.

WHITE GRUBS AND WIREWORMS.

White grubs and wireworms do considerable damage to beets, especially if beets are grown in prairie and alkali land. For control, see "White grubs" and "Wireworms" (pp. 16 and 17).

LEAF-SPOT.

In leaf-spot, circular, brown, dead spots appear on the leaves (fig. 33). Spray with Bordeaux mixture when the first spots appear and repeat at 10-day intervals.

CABBAGE.

COMMON CABBAGE WORM.

The common cabbage worm (fig. 34) is known to most farmers, and the butterfly is also a familiar object; but in some cases the growers do not associate the velvety green caterpillar with the parent white butterfly. This cabbage worm has been termed rightly the bane of the cabbage grower and the dread of every careful cook and housewife. It begins work early in the season, attacking the first young plants which it can find (fig. 35). After riddling the outer leaves, which remain afterward attached to the stalk, the worm attacks the tender inner leaves as they form, hiding in the immature heads, where it is difficult to reach it with a spray and rendering the cabbage heads unfit for food, partly owing to the filthy condition in which it leaves them. For this reason cabbage heads before being marketed must be examined with care and damaged leaves removed. They also should be washed thoroughly.

FIG. 33.—Beet leaf-spot.

In cool weather the caterpillars often feed freely exposed on the upper surface of the leaves in the sunshine, and at such times they are easy to combat. The cabbage worm does hardly less damage to cauliflower, kale, collards, turnips, radishes, and horse-radish. The butterflies occur even in the more northern States from March to October, and the worms are at work in the same region from April to September and occasionally later during warm winters.

Control.—Arsenate of lead is the best remedy, and while it leaves a coating on the outer leaves until late in the season, it remains to be seen whether this affects even domestic animals. These leaves always are removed before cooking, and whatever trace of arsenate might remain would not be injurious to the consumer. See Farmers' Bulletin 766.

FIG. 34.—The common cabbage worm (*Pontia rapae*): *a*, Female butterfly; *b*, egg (above as seen from above, below as seen from side); *c*, larva, or worm, in natural position on cabbage leaf; *d*, suspended chrysalis. *a*, *c*, *d*, Slightly enlarged; *b*, more enlarged.

OTHER CABBAGE WORMS.

Other species of butterflies as well as moths produce what are commonly called caterpillars, and these can not be readily identified by the average grower until full grown, since in their early stages they resemble one another. Of these there is the southern cabbage butterfly,[1] which resembles the common cabbage worm in the adult stage, being, however,

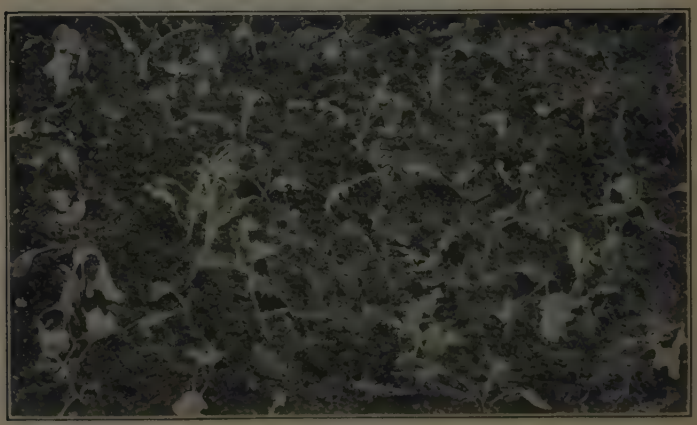

FIG. 35.—Cabbage seedlings grown in coldframes, showing injury by the common cabbage worm. This necessitates replanting and additional labor, and causes delay in getting cabbages to the early market.

[1] *Pontia protodice* Boisd.

perfectly white, while the worm is more strongly colored, purplish, and yellow striped, with black spots bearing black hairs. Another is the potherb butterfly,[1] a species practically confined to the North as a pest. The worm is uniform pale green and resembles closely the cabbage leaves on which it feeds. The cross-striped cabbage worm (fig. 36) is the young of a moth. It has the very bad habit of the common cabbage worm of boring into the head, and it is very difficult to dislodge.

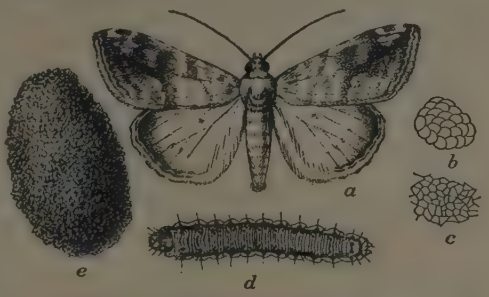

FIG. 36.—The cross-striped cabbage worm (*Evergestis rimosalis*): *a*, Moth; *b*, egg mass; *c*, portion of egg, highly magnified; *d*, larva, or worm; *c*, cocoon. Much enlarged.

Control.—The remedies advised as the best for the control of the common cabbage worm are valuable for all of these species.

CABBAGE LOOPER.

The cabbage looper (fig. 37) is the young, or worm, of a medium-sized moth resembling a cutworm moth. It is pale green and delicate looking when first hatched. When larger, it becomes striped and obtains its name of looper through its habit of doubling up, or looping, as it walks. It is more active than the other cabbage worms previously considered and is, therefore, more difficult to control. It affects all forms of cole crops, and at times does great injury to peas, beets, celery, and lettuce, even attacking the tomato and potato. It is apparently three-brooded from the District of Columbia northward to Long Island and is more destructive southward.

FIG. 37.—The cabbage looper (*Autographa brassicae*): Above, male moth; below, full-grown larva in natural position feeding, and pupa in cocoon just before development of moth. Moth and larva about one-third larger than natural size; pupa more enlarged.

Control.—Spraying with arsenate of lead is the best remedy. An adhesive, or "sticker,"

[1] *Pontia napi* L.

should be used when applied to cabbage, cauliflower, and similar smooth-leafed plants; otherwise the spray is not likely to adhere so well. In the kitchen garden hand picking is sometimes practiced. Clean farming is also desirable, and the clearing up and burning of all cruciferous weeds before planting. It is equally desirable in the case of this and other cabbage pests to destroy all injured plants and stalks by burning as soon as the main crop is harvested.

HARLEQUIN CABBAGE BUG.

The harlequin cabbage bug (fig. 38) is known also as the calico bug, fire bug, and terrapin bug. In the South this species is more

FIG. 38.—Harlequin cabbage bug (*Murgantia histrionica*): *a*, Adult; *b*, egg mass; *c*, first stage of nymph; *d*, second stage; *e*, third stage; *f*, fourth stage; *g*, fifth stage. Enlarged.

injurious than the common cabbage worm and, indeed, is classified as one of the most important pests of the country. The name "harlequin bug" aptly describes this species. It is gay red, ornamented like the harlequin of the stage. Normally it occurs from southern Virginia to California, but prefers the warmer States.

Control.—Of the direct methods of control nicotine sulphate is advised (see p. 10). Kerosene emulsion and fish-oil soap are less effective unless used strong. The newly hatched young are much

more easily killed than the harder and hardier adults. The plumber's torch is effective for this pest, destroying all the insects with which the flame comes in contact, after which the plants revive and grow well. The torch is more safely applied to the late fall crop. It is apt to injure the earlier, spring crop. These torches are not practical against many other insects, and their use should be restricted to this species and a few others. Other remedies are (1) clean culture, especially in the fall, (2) trap crops of mustard or other crops in the spring, and (3) hand picking of adults and eggs early in the season. The systematic destruction of this insect by means of a trap-crop method, i. e., planting early cole crops to attract the insects before the main crop is on and then destroying the insects by burning them, with the other methods advised, will help materially to keep this pest from doing much damage. Especially it is advisable to kill off the first and the last broods and to try to prevent the insect from gaining a foothold in the North.

FIG. 39.—The spinach aphis (*Myzus persicae*): *a*, Winged adult aphis; *b*, young nymph; *c*, older nymph; *d*, last stage of nymph, or pupa. Greatly enlarged.

PLANT-LICE.

Plant-lice of three species, known commonly as the cabbage aphis, turnip aphis, and spinach aphis (fig. 39), do much damage to cabbage in some seasons, but fortunately, although generally distributed, they are not injurious in all years in all localities. These insects so closely resemble one another that a description hardly would appeal to the grower who maintains a vegetable garden as a side issue. They appear early in the spring and sometimes remain as late as December.

Control.—The best remedy is nicotine sulphate (see p. 10). Kerosene emulsion and soaps, especially fish-oil soap, also are valuable, and a strong stream of water frequently directed upon the plants from a syringe, garden hose, or sprayer is often of service in checking these pests. The early application of remedies is advisable. Clean culture, as for the harlequin cabbage bug and other insects affecting cole crops, should also be practiced.

FLEA-BEETLES.

Several forms of flea-beetles attack young cole crops, generally preferring cabbage, some of them being striped and others plain

greenish or bluish in color. They are a little larger than fleas and have the same jumping habits. Nevertheless they can be controlled by lead arsenate employed as for cabbage worms. Bordeaux mixture with resin fish-oil soap is an excellent deterrent. (See p. 7.)

THE CABBAGE MAGGOT.[1]

Cabbage and related crops frequently suffer severe injury from the attack of the cabbage maggot, an insect closely related to the seed-corn maggot (fig. 57, p. 52) and very similar in appearance. Young plants are the ones most seriously affected, the maggots eroding the outer surface and boring into the interior of the roots, devouring the tender rootlets and frequently penetrating into the lower portion of the stalk. This maggot does the most serious injury throughout the northern tier of States and Canada, attacking all forms of crucifers, whether wild or cultivated. In that region it is the cause of loss to crops year after year, but, as with other destructive insects, it is much more abundant in some seasons than in others. When it occurs in abundance it is one of the most difficult pests to control unless use is made of tarred paper pads and other methods to be described.

Control.—The remedies prescribed for the seed-corn maggot (see p. 28) are sometimes applicable. In addition there are certain preventives and measures for its destruction that have been found successful, their use being justified by the great value of cabbage plants.

Carbolic-acid emulsion, prepared as advised (p. 8) is particularly applicable when this maggot occurs on radish and plants other than cabbage and cauliflower.

Hand picking, although laborious, has the merit of being effective, and is practiced with considerable success by those growing cabbage on an extensive scale, although not practicable on radish, turnip, and similar crops. It consists in pulling up the young cabbage or cauliflower plants, examining the roots for eggs and maggots, and destroying the eggs and maggots by crushing them with the hand or by washing the roots in a strong solution of soap, and then replanting. In most cases the plants show no ill effects from this treatment after two or three weeks have elapsed. On close examination the minute white eggs may be seen about the stalks of young cabbages; and if the earth be raked away so as to expose the eggs to the sun, these will dry up, thus preventing the maggots from hatching. Afterwards the plants should be hilled.

Although little is to be expected from certain farming methods which are sometimes perfect safeguards against other insects, the following measures are helpful. Keeping the soil well hilled around the plants promotes root development, thus lessening the likelihood

[1] *Pegomya brassicae* Bouché.

that the plants will succumb to any ordinary attack. A rotation should be practiced in which cabbage, cauliflower, etc., are followed by plants other than cole crops. Fall plowing is advisable. Crop remnants, and particularly cabbage stumps, should be removed and destroyed, especially early in the season, since this protects other cole crops against other pests which are harbored in the old stalks or feed on the new leaves in early winter, to reappear the next spring.

The use of disks or pads of tarred paper for the protection of cabbage against the oviposition of the fly was perfected in 1889 as follows:

The cards are cut in a hexagonal form (fig. 40, *c*) in order better to economize the material, and a thinner grade of tarred paper than the ordinary roofing felt is used, as it is not only cheaper, but, being more flexible, the cards made placed about the plants without being torn.

The blade of the tool, which should be made by an expert blacksmith, is formed from a band of steel, which is bent in the form of a half hexagon, and then, taking an acute angle reaches nearly to the center, as shown in figure 40, *a*. The part making the star-shaped cut is formed from a separate piece of steel, so attached to the handle as to make a close joint with the blade. The latter is beveled from the outside all around, so that by removing the part making the star-shaped cut the edge may be ground on from it are more readily a grindstone. It is important that the angles in the blade be made perfect, and that its outline represent an exact half hexagon.

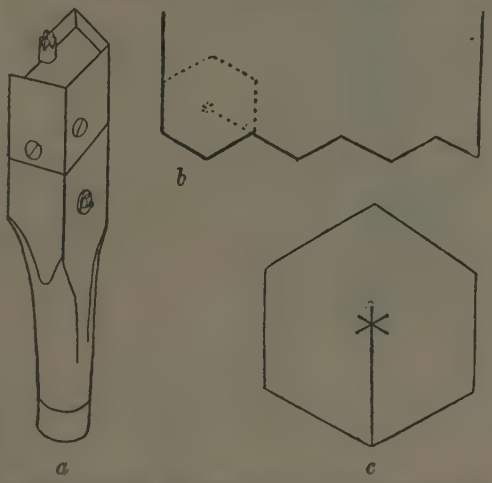

FIG. 40.—*a*, Tool for cutting tarred paper pads; *b*, diagram showing how tool is used, the dotted line showing position of edge of tool; *c*, tarred paper pad in outline. *a*, *b*, One-fourth natural size; *c*, one-half natural size.

To use the tool, place the tarred paper on the end of a section of a log or piece of timber and first cut the lower edge into notches, as indicated in figure 40, *b*, using only one angle of the tool. Then commence at the left side and place the blade as indicated by the dotted lines, and strike at the end of the handle with a light mallet, and a complete card is made. Continue in this manner across the paper. The first cut of every alternate course will make an imperfect card, and the last cut in any course may be imperfect, but the other cuts will make perfect cards if the tool is correctly made and properly used.

The cards should be placed about the plants at the time of transplanting. To place the card, bend it slightly, to open the slit, then slip it on the center,

the stem entering the slit, after which spread the card out flat and press the points formed by the star-shaped cut snugly around the stem.

A Wisconsin grower protected 7,000 plants and secured a splendid crop, while unprotected plants near by would have been a complete failure if the maggots had not been picked off by hand. Others have reported similar success. One reported having lost only 25 plants out of 10,000 to 15,000 that he protected with the cards, where ordinarily he would have lost from 75 to 90 per cent of the crop. Some growers in Wisconsin have used this method with almost perfect success for upwards of 20 years. The tarred pads are applicable to cabbage and cauliflower only, but they are cheaper, more practicable, and more efficient than anything else yet devised for preventing the ravages of the cabbage maggot. Success in using them is dependent upon their being properly applied, *to fit tightly*, so that the fly will be unable to obtain access to the stem to lay her eggs. Pads must be renewed and their use continued every year, to be effective.

FIG. 41.—Cabbage black-leg.

BLACK-LEG.

In black-leg the plants show a purple color and the leaves wilt, but remain adhering to the stem. Sunken, diseased spots occur on leaves and stem, in which numerous tiny black specks may be seen. The stem is often girdled. (Fig. 41.)

Preventive measures.—(1) Disinfect seed with corrosive sublimate, 1 tablet to a pint of water for 10 minutes; (2) use disease-free soil for the seed bed; (3) avoid contaminated manure; (4) in setting plants use no contaminated water; (5) practice a long crop rotation.

FIG. 42.—Cabbage yellows.

YELLOWS.

The leaves of cabbage often yellow and fall off, the lower ones first, leaving a bare stem and small, imperfect head. (Fig. 42.) The inner wood of the stem is blackened. The yellowing of the leaves and of the plant is often one-sided. This disease is caused by a soil fungus.

Control.—Resistant varieties are being bred. Until these are available, practice the same treatment as for black-leg.

BLACK-ROT.

In black-rot, dead brown areas appear on the leaf margins. The disease progresses downward through the veins, which are blackened. The inner wood of the stem is dark. (Fig. 43.) The heads are dwarfed or one-sided, and later may decay and fall off.

Control is difficult. Use the same preventive measures as for black-leg. Keep insects, slugs, snails, etc., in subjection, as they may spread the disease. Pull or destroy diseased plants.

FIG. 43.—Cabbage black-rot. Cross section of stem of diseased plant, showing blackened ring.

CLUBROOT.

The plants may be attacked by clubroot in the seed bed or later. They are stunted, sickly, and wilt during the heat of the day. The roots become greatly swollen and malformed. (Fig. 3, p. 6.) This disease also attacks turnips, cauliflower, mustard, and other cultivated and wild plants of the cabbage family.

Control.—Apply lime, preferably air slaked, at the rate of 40 pounds per square rod, working it deep into the soil several months before planting. Take special care that the seedlings are healthy. Destroy diseased plants.

SOFT-ROT.

The heads go down rapidly in the field, especially in warm weather, with a soft rot. Harvest early and avoid replanting the same spot.

CELERY.

LEAF-BLIGHT.

FIG. 44.—Celery leaf-blight.

Leaf-blight is a spotting of the leaves (fig. 44). There are two forms, the early and the late, due to different fungi, but controlled by the same means. Spray the celery in the seed bed with Bordeaux mixture and repeat every 10 to 14 days until the celery is mature.

A comparatively small number of injurious insects affect celery, with the exception of general feeders. Those which prefer celery usually live also on the related plants, carrots, parsley, and parsnips. For convenience, pests of these plants may be considered together.

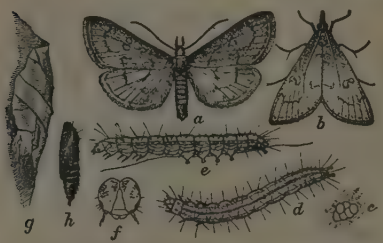

FIG. 45.—The celery leaf-tyer (*Phlyctaenia ferrugalis*): *a*, Moth; *b*, same in natural position at rest; *c*, egg mass; *d*, larva from above; *e*, same from side; *f*, head of same; *g*, pupa case; *h*, chrysalis. *a*, *b*, *d*, *e*, *g*, *h*, one-half larger than natural size; *c*, twice natural size; *f*, more enlarged.

CELERY LEAF-TYER.

The celery leaf-tyer (fig. 45) is known also as the greenhouse leaf-tyer. While more abundant in greenhouses, attacking various plants, such as the roses, violets, and carnations, it is injurious to garden celery, cabbages, beets, lettuce, cauliflower, parsley, and cucumbers. The moth has a wing expanse of about three-fourths of an inch and is clay-brown, ornamented with black lines. The larva, or caterpillar, is green or greenish yellow, nearly transparent, with darker head, and striped. The leaf-tyer usually works on the under side of leaves, chiefly at night, resting by day in the same location.

FIG. 46.—The celery caterpillar (*Papilio polyxenes*): *a*, Larva from side; *b*, larva showing head with odoriferous appendages; *c*, male butterfly; *d*, outline of egg; *e*, young larva; *f*, chrysalis. All about natural size except *d*, which is much enlarged.

Control.—It can be hand picked successfully in the small home garden. Lead arsenate should be used in larger areas.

CELERY CATERPILLAR.

Wherever celery, parsley, carrots, or other plants of the celery family are grown, a large green or yellowish caterpillar ringed with black is sure to be found. It is known as the celery caterpillar (fig. 46) or parsley worm. It feeds normally on the leaves, but when abundant attacks blossoms and undeveloped seed. When disturbed the caterpillar gives out a powerful scent.

Control.—The conspicuous appearance of this worm makes hand picking easy. If the first brood is killed there will be little damage from the second brood. Lead arsenate can be used when necessary in large gardens devoted to a single crop of celery, parsley, or related plants.

TARNISHED PLANT-BUG.

The tarnished plant-bug (fig. 15, p. 20) is one of the worst enemies of celery. As a rule it does not do so much damage to other garden plants.

CELERY LOOPER.

The celery looper[1] somewhat resembles the cabbage looper (see p. 33) and has a similar life history. The same remedies may be employed for it, especially arsenate of lead. The loopers also may be collected by hand.

CORN.

Sweet corn is so badly infested by insects of many species that it is undesirable to plant it in many cases, considering the difficulty of obtaining good localities for its growth in small gardens.

CORN ROOT-APHIS.

The corn root-aphis is bluish green, slightly whitened by a waxy bloom. It spends most of its life feeding at the roots, but winged forms appear which migrate to various weeds, especially smartweed, mustard, pigweed, and plantain.

Control.—Crop rotation, with care not to plant in or near fields of weeds, free use of fertilizers to stimulate plant growth, and disturbing and destroying the nests of ants which attend this species and foster it by carrying the young from one plant to another are advisable. Fall plowing and late planting of corn are also useful.

SOUTHERN CORN ROOTWORM.

The larvæ, or young, of the southern corn rootworm, known as budworm and drillworm, do great damage to corn of all kinds and to several other food plants, including peanuts.

Control.—This is considered under the 12-spotted cucumber beetle, page 44. When occurring on corn, insecticides are of little value. Injury is greatest to corn when planted in damp locations and

[1] *Autographa simplex* Guen.

in meadows. Rotate with cotton, buckwheat, and the smaller grains, and with any vegetables other than beans, peanuts, and cucurbits.

CORN EARWORM.

The corn earworm is the same species as the bollworm of cotton and the fruitworm of tomato (see figs. 79 and 80, p. 68). Ears of corn and pods of beans, cowpeas, and related plants are often found bored with holes, and the seed devoured within. This insect is also called the tobacco budworm, and it attacks pumpkins, squashes, melons, peppers, okra, and various other vegetables. Attack begins on corn in the silk, and even if only one ear is attacked this frequently leads to the entrance of other injurious insects; rain is apt to enter, and decomposition sets in. The moth which produces this caterpillar is ocher yellow in color, more or less variegated with darker markings, and measures about 1½ inches across its spread forewings. The corn earworm itself is extremely variable in color, different shades of purple, pink, and green prevailing; it is more or less strongly striped longitudinally with black and bears prominent tubercles or warts.

Control.—Lead arsenate applied to the silk early in the season and the application repeated when found necessary will reduce the injury to some extent. Here the powder form dusted on the silk is of greatest value, but even when applied by experts not more than 50 per cent of the ears have been saved.

Crop rotation is of little value, as the insect feeds on all forms of plants, including grasses and clover, and on these plants it is seldom noticed. No variety of corn is known which is absolutely free from attack, but late sweet corn, such as Blue Flint, Stowell's Evergreen, and Country Gentleman, are less liable to injury than others.

CUTWORMS.

Cutworms and other caterpillars are often found on corn, and may be hand picked or poisoned in a vegetable garden.

FLEA BEETLES.

Two forms of flea-beetles are commonly found on sweet corn, and they may be destroyed by lead arsenate combined with Bordeaux mixture, or Bordeaux mixture alone will repel them.

WHITE GRUBS AND WIREWORMS.

Corn is susceptible to attack by wireworms and white grubs. (See pp. 16 and 17.)

SEED-CORN MAGGOT.

See "Bean fly, or seed-corn maggot" (p. 28).

BACTERIAL BLIGHT (STEWART'S DISEASE).

In bacterial blight the affected plants die by wilting and drying up. The leaves usually wilt one after another. The plant may live for a month or die in four or five days. If a cross section is made of the stem, in about five minutes a yellowish, sticky substance will ooze out from the cut ends. The midrib of the leaves is similarly affected. Some varieties are somewhat resistant.

Rotate crops and destroy infected plants.

FIG. 47.—The striped cucumber beetle (*Diabrotica vittata*): *a*, Beetle; *b*, larva; *c*, pupa. Much enlarged.

SMUT.

Smut is characterized by the appearance of large, irregular boils on the ears, tassels, or other parts of the plant, covered at first with a white membrane, but later breaking open and scattering dirty masses of spores.

Cut and burn the smut boils before they burst.

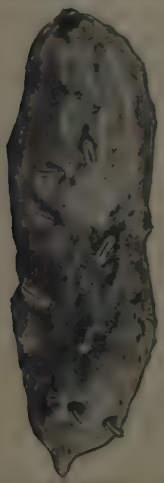

FIG. 48.—Striped cucumber beetles feeding on a cucumber after frost has killed the foliage.

CUCUMBER.

STRIPED CUCUMBER BEETLE.

The striped and 12-spotted cucumber beetles occur throughout the eastern United States. In other regions several other species occur, all closely related, having very similar habits and yielding to about the same remedies. The common form is known as the striped cucumber beetle (fig. 47), sometimes called the striped bug, melon bug, or "cuke" bug. The beetle measures about three-sixteenths of an inch in length. It is yellow above, with black head and wing covers bearing three black stripes; whence the name. The worm, or larva, is slender and white-brownish at each end.

Injury is due mainly to overwintered beetles eating tender plants. They also injure older plants, eating leaves and gnawing stems and roots. The beetles usually appear in April or May. Only one generation has been observed thus far. The beetles late in the season congregate about the stems and leaves of cucurbits and later seek shelter, frequently remaining until the first cool nights

of October, or later or earlier, according to season and locality. Figure 48 shows the work of this species on cucumbers. In the worm stage this species causes damage to the roots. This, however, is seldom noticed. The beetles are carriers of cucurbit wilt and mosaic disease.

FIG. 49. The 12-spotted cucumber beetle (*Diabrotica duodecimpunctata*): *a*, Beetle; *b*, egg; *c*, larva; *d*, anal segment of larva; *e*, work of larva at base of cornstalk; *f*, pupa. All much enlarged except *c*, which is reduced. (Riley, except *f*.)

Control.—The simplest remedy for garden use is covering young plants with a *cheesecloth-covered* frame made by cutting a barrel hoop in two, so as to form two semicircles. These are placed at right angles to each other and the lower ends sharpened and inserted in the ground with the curve uppermost. A cheap mosquito netting covering is readily penetrated by the beetles, and heavy cloth keeps out the sunlight. The lower edges must be held down by stones or other weights.

Plants may be set out as early as possible and thus avoid the beetle, although there is danger of frosts.

Another method is to plant more seed than is necessary by planting once each week in one of the squares as represented below:

1 : 2
3 : 4

The first and second plats are often killed, and sometimes the third, but as long as the insects are poisoned with lead arsenate a good stand is almost sure to be secured.

Lead arsenate as used for the Colorado potato beetle is the most useful remedy against this species. Bordeaux mixture, added to the lead arsenate, acts as a repellent and prevents injury to the foliage so treated.

TWELVE-SPOTTED CUCUMBER BEETLE

The 12-spotted cucumber beetle (fig. 49) is a little larger than the striped species and eats practically everything, and when it occurs on

cucumbers it is to be treated in the same way. The young, or larva, is known as the budworm and less commonly as the drillworm, but more properly as the southern corn rootworm. The adult, or beetle, is, perhaps, the most general feeder known, attacking "everything green." The larva, however, breeds chiefly in grasses and corn, although also on weeds and even on peanuts.

Control. — Rotation of crops, spraying with lead arsenate, and otherwise treating in the same manner as the striped cucumber beetle, are the remedies employed in small areas of cucurbits. Avoid planting in grasslands after corn and weeds.

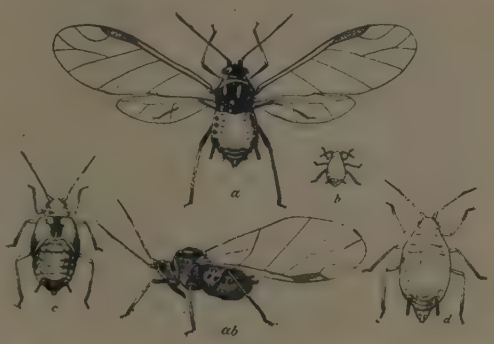

FIG. 50.—The melon aphis (*Aphis gossypii*): *a*, Winged female; *ab*, dark female, side view; *b*, young nymph, or larva; *c*, last stage of nymph; *d*, wingless female. All much enlarged.

MELON APHIS.

The melon aphis (fig. 50), commonly called the melon "louse," injures cucumbers and other plants by piercing them and sapping their vital juices. It occurs from early

FIG. 51.—Cantaloupe leaves showing curling caused by the melon aphis. Slightly reduced.

spring and summer to late autumn and early winter on melons and other cucurbits, and on many other crop plants. In seasons which favor its increase, notably in summers following springs that are cool and rainy, it frequently appears in enormous numbers and does very serious damage, collecting in masses on the under side of the leaves of plants and causing them to curl, shrivel, and lose color, and interfering with the ultimate development of the fruit. Often it kills plants outright and destroys whole fields or greatly reduces the yield of fruit. An affected cantaloupe plant is illustrated by figure 51.

The melon aphis, like others of its kind, excretes honeydew. When this aphis becomes unusually abundant, the honeydew covers the leaves with a thin, sticky coating on which the white cast skins of the plant-lice adhere, and this attracts attention to the injury, as do also wilting and dying down of the plants. Some persons notice this honeydew and are unaware of the presence of the insects. They speak of the injury as honeydew, and have even applied this name to the insect itself.

FIG. 52.—Cucumber anthracnose.

By the time the presence of the melon aphis in injurious numbers is noticed, irreparable damage frequently has been accomplished and the insects for the most part have migrated to other pastures. This species is minute and varies from yellowish or greenish to jet black. It is generally distributed throughout the country. It finds alternate food plants in other cucurbits, cotton, okra, orange, strawberry, and some other plants, including weeds.

Control.—The best remedy is nicotine sulphate (see p. 10), which, if properly applied, will control not only this pest but the young of squash bugs, and will act to a certain extent against such soft-bodied insects as may be present at the same time.

WILT.

Wilt is usually the first disease to appear in the spring, often causing plants to wilt suddenly and die when only 6 or 8 inches tall,

and it may continue to attack plants throughout the season. The disease is caused by bacteria which grow in the water vessels of the plant, thus cutting off its water supply. As the disease is carried largely by the striped cucumber beetle, the plants should be kept covered as long as possible with insect-proof cages (see "Striped cucumber beetle," p. 43) or sprayed with lead arsenate, one-half pound dry to 10 gallons of water, to kill the beetles. Diseased plants should be pulled promptly and burned or buried.

ANTHRACNOSE.

Anthracnose (fig. 52) is a disease affecting principally the leaves and stems of the plant. It causes brown spots, one-fourth to one-half inch in diameter, on the leaves, which when numerous kill them. The oldest leaves in the center of the plant are attacked first, about the latter part of July in the latitude of northern Ohio. With warm, moist weather the disease spreads rapidly, and the plants are often completely killed before the end of the season. Thorough spraying with Bordeaux mixture will hold the disease in check but will not entirely control it. Cucumbers should not be planted in the same place in succeeding years. This disease and the next may be spread by infected seed.

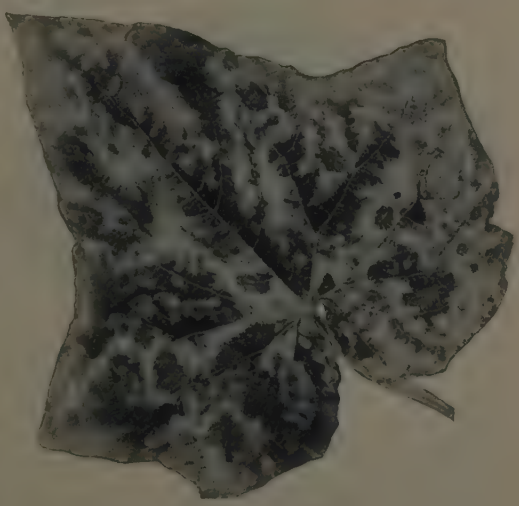

FIG. 53.—Cucumber leaf, showing mosaic disease.

ANGULAR LEAF-SPOT.

Angular leaf-spot attacks the leaves in late July, causing angular spots one-sixteenth to one-eighth of an inch across, first water soaked, later sometimes whitened, and during continued wet weather it may cause considerable damage. It can be controlled largely by spraying with Bordeaux mixture.

MOSAIC DISEASE.

The mosaic disease, sometimes called "white pickle," occurs throughout the Middle West and causes mottling of the leaves (fig. 53), warting of the fruits (fig. 54), stunting and yellowing of the plants, and great reduction of the yield. The cause of

the disease is as yet unknown, but it is certain that it is carried from plant to plant by insects, by pickers, and in other ways. It may appear as early as July 10 in the Middle West. Satisfactory control measures have not been discovered, but the plants should be kept covered with insect-proof cages as late as possible to keep insects off. Later they should be dusted with equal parts of tobacco dust and lime or sprayed with Bordeaux mixture and lead arsenate (half a pound dry to 10 gallons). See "Striped cucumber beetle" (p. 43).

DOWNY MILDEW.

Downy mildew is a fungous disease which attacks the leaves during warm, moist weather after the middle of the season, causing yellowing, with faintly defined angular spots, followed by curling and death in a few days. The oldest leaves are attacked first. If the plants are sprayed thoroughly with Bordeaux mixture every 7 to 10 days, beginning when the first symptoms of the disease appear, they can be kept in bearing condition for two or three weeks longer than unsprayed plants.

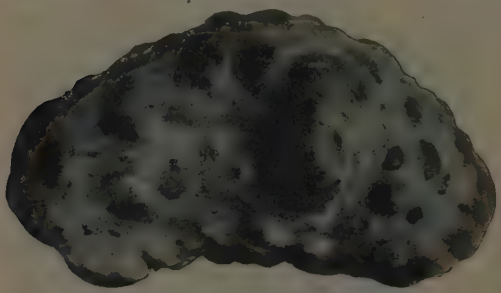

FIG. 54.—Cucumber mosaic disease, or "white pickle."

SCAB.

Scab is a fungous disease which attacks the young leaves, stems, and fruits, causing sunken, gray spots on the fruits which spoil them for use. The disease does not appear until late in the season. In moist weather it is often very severe and every fruit on a plant may be affected. Because of the rapidity of spreading under ordinary conditions and the fact that it attacks the young fruits even when in the blossom stage, it is extremely difficult to control.

GENERAL RECOMMENDATIONS FOR THE CONTROL OF CUCUMBER DISEASES IN GARDENS.

Disinfect seed by soaking five minutes in dilute formaldehyde (1 teaspoonful to 1 cup of water), wash in water, and dry or plant. Plant in hills and cover with insect-proof cages and keep these on as long as possible. If insects are troublesome when cages are removed, some will be destroyed by dusting plants with equal parts of tobacco dust and air-slaked lime or by spraying with lead arsenate (one-half pound dry or 1 pound paste to 10 gallons of water). Pull and burn

or bury, as soon as found, plants having mosaic or wilt. Spray with Bordeaux mixture as soon as the first evidences of downy mildew are found.

EGGPLANT.

Eggplant is subject to the attack of the same insects as potatoes, which are treated on pages 55 to 57. After the Colorado potato beetle has attacked the first crop of potatoes, it continues work on eggplant.

EGGPLANT LACE-BUG.

The eggplant lace-bug (fig. 55) has been injurious in recent years. It feeds by sucking and sometimes is accompanied by plant-lice. Nicotine sulphate at the rate of 2 ounces to 12 gallons of water will kill all nymphs and most adults. See "Nicotine sulphate" (p. 10).

FRUIT-ROT.

Fruit-rot of eggplant is a disease occurring on the leaves and stem, as well as on the fruit, which causes it to rot rapidly. It also causes a damping-off of seedlings.

No effective control measures are known. Destroy diseased fruits or plants.

WILT.

The plants sometimes wilt suddenly and die. Pull and destroy diseased plants. Rotate.

FIG. 55.—The eggplant lace-bug (*Gargaphia solani*): Adult. Greatly enlarged. (Fink.)

LETTUCE.

Lettuce is attacked by the lettuce root-louse, the cabbage looper, the celery caterpillar, cutworms, thousand-legged worms, and about four species of plant-lice. Lettuce frequently watered is often free from insects.

Control of lettuce insects.—It is extremely difficult to treat any of these pests in the garden with insecticides, because of the danger of poisoning the consumer or injuring the plants. When very young

the plants may be treated safely with either arsenate of lead or nicotine sulphate, as the poisoned leaves will not be eaten.

DROP.

When plants are attacked by the disease known as drop they wilt suddenly and die. There may be found in the decaying heads small, gray to black fungous masses, or sclerotia, which remain in the soil to carry the disease over unless the plants are taken up and destroyed on the first evidence of disease.

Replant in another place.

TIPBURN.

Head lettuce often develops a browning of the leaf margins known as tipburn. This is due to the hot sun and lack of water. Prevent by watering, and make the soil rich with rotted stable manure.

Other lettuce troubles occur, but it does not pay to treat them in the home garden. Plant a new bed.

MUSKMELON OR CANTALOUPE.

Cantaloupes are affected by the same insects which attack cucumbers, the melon aphis and cucumber beetles being particularly troublesome. See "Cucumber" (p. 43).

FIG. 56.—Muskmelon leaf-spot.

LEAF DISEASES.

The spotting and death of muskmelons are usually due to one or another of three fungi, the most common being shown in figure 56. Control by spraying with Bordeaux mixture, applied first when the vines begin to run and repeated every 7 to 10 days. Rotation is important for the crop.

WILT.

See cucumber wilt, page 46.

ONION.

The onion and other bulbous crops often are affected seriously by insects in the field. The common and Welsh onions, garlic, leek, chives (or sives), and shallot are subject to

attack by the same insects, but comparatively few species injure onions as a rule, the onion thrips (see p. 19) and onion maggot causing the greatest damage.

ONION THRIPS.

The onion thrips is a general pest and is considered on page 19.

THE ONION MAGGOT.[1]

Injury due to the onion maggot is the most important drawback to the culture of onions. It is accomplished by the consumption of the bulb, inducing subsequent decay of the affected portions and their very frequent destruction.

The fly and the minute maggot resemble the seed-corn maggot (fig. 57, p. 52), although averaging a little larger. The male is gray, with black bristles and hairs; it has a white face with black hairs, and there are three dark lines on the body between the wings and a row of black spots on the abdomen. The female is a little larger, inclined to dark yellowish, and has a pale yellowish face.

As in the case of the cabbage maggot, this is a northern form, and two or three generations evidently are the rule.

Control.—The methods advised for the seed-corn maggot (p. 28) frequently are about all that are necessary for this species. The tarred pads can not be conveniently or economically used on onion. The flies are probably attracted to old onion beds and to crop remnants; hence, clean field methods are always advisable. One of the best remedies is carbolic-acid emulsion (p. 8), but the best one known is a poisoned bait to attract and kill the flies. This bait is made as follows:

Sodium arsenate	ounce	½
Water	gallon	1
Cheap molasses	pint	1

Dissolve the arsenate of sodium in boiling water and then add the molasses. This bait has proved to be cheap, attractive, and effective. Since it is not necessary to cover the foliage, the bait may be applied in large scattering drops. An ordinary syringe, or a whisk broom dipped into a bucket of the solution and shaken about on each side of the operator, will apply the bait satisfactorily. This poisons the flies as they are attracted to the fields. Perfect stands of onions have been secured by this method—some of the best that have been secured for many years.

OTHER ONION INSECTS.

More often than not the onion maggot is accompanied by the seed-corn maggot (fig. 57), which has also been called the bean fly. Some

[1] *Pegomya cepetorum* Meade.

other root maggots are frequently injurious, as are certain wireworms (p. 17) and the tarnished plant bug (p. 19).

MILDEW.

When onions are affected with mildew the tops wither and die. A violet mildew may be seen on the diseased areas. If detected in time, spray with Bordeaux mixture and resin fish-oil soap.

FIG. 57.—The seed-corn maggot (*Pegomya fusciceps*): *a*, Male fly, dorsal view; *b*, female, lateral view; *c*, puparium; *d*, larva, from side. All much enlarged.

SMUT.

In onion smut the young seedlings are covered with pustules filled with a black powder. This disease remains in the soil. If no clean ground can be had, apply formaldehyde solution in the drill, after dropping the seed and before covering it, at the rate of 3 to 4 quarts per 100 feet of row. Onion sets are not subject to smut injury.

PEAS.

Garden peas are attacked by the same insects as those mentioned under "Beans" (p. 25). For convenience cowpeas will be mentioned here as they are generally known throughout the South as "peas," while in the North one form is called black-eyed peas, or beans, a variety which is much cultivated for human food. Among those insects which feed on the leaves are the bean ladybird, blister beetles, and cutworms and other caterpillars. See "Beans" (p. 25). There are, however, a few insects which attack peas in preference to beans. The principal ones of these are the pea weevil and the pea aphis.

The cowpea weevil and 4-spotted bean weevil are in the same category as the pea weevil.

PEA WEEVIL.

Fig. 58.—The pea weevil (*Bruchus pisorum*): *a*, Adult; *b*, larva; *c*, pupa. Much enlarged.

Seed peas often may be found with a single round hole in each, due to attack by the pea weevil (fig. 58), or "pea bug," a beetle measuring about one-fourth of an inch in length. While this insect is black in ground color, it is thickly covered with a brownish fuzz, with black and white markings. It is a pest of long standing in this country. On account of its ravages, seed peas are largely imported from Canada and the extreme northern States. Every pea in a pod when ready for the table often is infested with this weevil. The only outward appearance on the green pea to show that it contains worms is a minute dot, which seldom will be noticed. In the dry seed, however, the cell inhabited by the insect is quite plainly seen under the skin. Many weeviled seeds germinate, but they are likely to be weak and nonproductive. Since this species produces only one generation a year, it is more readily treated than are the bean and cowpea weevils.

Fig. 59.—The 4-spotted bean weevil (*Bruchus quadrimaculatus*): *a*, Beetle; *b*, larva; *c*, pupa. Much enlarged.

Control.—Keep seed peas in a warm room, in a tight bag or box, one full season before planting. The weevils will issue from the seed and die. Plant late in order to secure sound seed stock. Fumigate with carbon disulphid. (See Farmers' Bulletin 799.) Do not plant weeviled or "buggy" peas, as it will not pay.

Fig. 60.—The cowpea weevil (*Bruchus chinensis*): Adult male beetle. Much enlarged.

COWPEA WEEVIL AND FOUR-SPOTTED BEAN WEEVIL.

The 4-spotted bean weevil (fig. 59) and the cowpea weevil (fig. 60) resemble each other rather closely. While both favor cowpeas as food, they also live on table beans in the South—peas, chickpeas, and, in fact, all leguminous

seeds large enough for them to develop within. They differ from the true pea weevil in that they produce several generations each year on dry seed.

Control.—Fumigate with carbon disulphid. (See Farmers' Bulletin 799.)

PEA APHIS.

The pea aphis (fig. 61) is one of the larger species of plant-lice, measuring about three-sixteenths of an inch, with a total wing expanse of about four-tenths of an inch. It is uniform pea green, the same as its food plants. Attack begins on young vines, the "lice" gathering in clusters about the terminals or tips. Later they attack the stems and sap the life of the plant.

FIG. 61.—The pea aphis (*Macrosiphum pisi*): *a*, Winged female; *b*, same from side, with wings folded in natural position, as when feeding; *c*, wingless female; *d*, nymph in last stage. Much enlarged.

Control.—Nicotine sulphate and kerosene-soap emulsion are good remedies if applied when the insect first begins attack early in the spring. If peas are grown in rows wide apart to permit a one-horse cultivator between them, the "lice" can be brushed off with boughs of pine with the leaves on, following with the cultivator immediately afterwards to bury the pest. Pine boughs also may be used by hand. Crop rotation is advisable. It appears that this insect affects practically no other garden crop than peas. Alternate plants are clover, alfalfa, field peas, and several leguminous weeds.

MILDEW.

Mildew of peas is indicated by a gray-white mold covering the leaves and pods. Dust with sulphur or spray with Bordeaux mixture.

LEAF AND POD SPOT.

Dark spots sometimes appear on leaves and pods. This trouble is known as leaf and pod spot and spreads in the seed. There is no effective treatment. Save seed from healthy pods.

STEM-BLIGHT.

When peas are affected by stem-blight the stems shrivel and decay at the soil line. Rotate.

POTATO.

COLORADO POTATO BEETLE.

If careful watch is not kept, the Colorado potato beetle (fig. 62) is certain to exact a heavy toll. This beetle and its "slugs" are so well known that no description is necessary here.

The range of this pest covers a large portion of the United States, but it is not found extensively or in especially injurious numbers

FIG. 62.—The Colorado potato beetle (*Leptinotarsa decemlineata*) and "slugs," or larvæ, at work. Slightly colored.

near the Rocky Mountains. It abounds from New England and Canada to Florida, westward to Texas, and in the northern Pacific region, where it has become troublesome only recently. Both the "slugs" (the young, or larvæ) and the beetles (adults) feed upon the potato plants. After passing the winter in the ground, the beetles usually appear at about the same time as the potato plants, lay their eggs, and continue feeding. They often destroy small areas, especially those grown for garden purposes. When the "slugs" of the first crop begin their work they usually finish up that begun by the overwintered beetles, leaving only bare stems, which become dry and black. After exhausting the potato, the beetles attack eggplant and other plants of the potato family, including tomato, ground cherry, jimson weed, and related weeds. In the most northern range of this insect there is probably only one generation a year, but two generations and a partial third occur southward.

FIG. 63.—The potato tuber moth (*Phthorimaea operculella*): *a*, Larva, or "worm," seen from above; *b*, moth with wings expanded; *c*, pupa. Much enlarged. (Graf.)

Control.—Ducks, guineas, and other domestic fowls eat the beetles and larvæ. So also do snakes, toads, and skunks, which frequently gorge on them. Arsenate of lead is the best remedy, applied as advised on page 9.

BLISTER BEETLES.

Blister beetles are next in importance to the Colorado potato beetle as potato insects. They are slender, somewhat soft bodied, of various colors, and feed upon all forms of garden truck, appearing to prefer potatoes, following with beans, peas, and related crops, beets, cabbages, squashes, and others. When occurring on the potato, they are sometimes called the "old-fashioned potato bugs."

Control.—Lead arsenate is the best remedy, prepared and applied as directed for the Colorado potato beetle, but driving and burning also are useful. See "Blister beetles" (p. 17).

THE POTATO TUBER MOTH.

The larva, or "worm," of a small gray moth, the potato tuber moth (fig. 63), is the worst potato pest known in California. (See fig. 64.)

It occurs more sparingly in other States, for example in Texas and in Florida, and injures the tomato and eggplant. From its injury to tobacco it has been called the "splitworm."

Control.—For further information and control, see Farmers' Bulletin 557.

FLEA-BEETLES.

Small round holes in potato leaves and in various related crop plants, such as tomato and eggplant, show the presence of flea-beetles, which have been described on pages 35 and 36.

FIG. 64.—Potato sliced to show advanced injury by potato tuber-moth larvæ. (Graf.)

Control.—Lead arsenate applied as a spray is the most valuable remedy (see p. 9), especially when combined with Bordeaux mixture. Bordeaux mixture alone is an excellent repellent (see p. 6).

CUTWORMS.

Early potatoes are much attacked by cutworms, and frequently late potatoes suffer from the same pest. See "Cutworms" (p. 14).

WHITE GRUBS AND WIREWORMS.

White grubs and wireworms injure the tubers in the earth, which are a favorite food of these pests.

Control measures are considered under "White grubs" and "Wireworms" (pp. 16 and 17).

SCAB.

Scab is shown by rough-pitted spots due to a parasite which lives in the soil. It is spread by planting scabby potatoes. (See fig. 65.) The seed potatoes therefore should be disinfected by soaking, before cutting, 1½ hours in a 1 to 1,000 solution of corrosive sublimate or 2 hours in formaldehyde, 1 to 240. (See p. 8.) Five and one-half gallons of the solution will cover a bushel of potatoes.

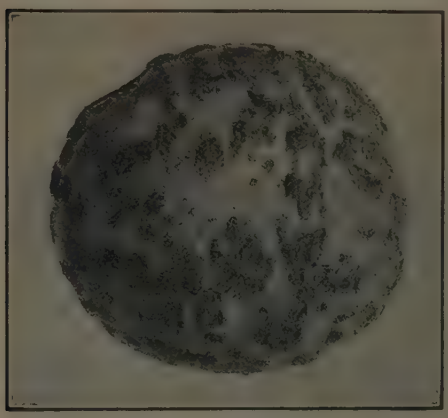

FIG. 65.—Potato scab.

When the garden has become infected, seed treatment will not prevent scab. Avoid lime, fresh stable manure, and wood ashes. Turn under green crops. Plant potatoes elsewhere if possible. Procure Farmers' Bulletin 544.

WILT AND DRY-ROT.

To guard against wilt and dry-rot, sort seed potatoes critically. Cut a slice from the stem end one-fourth inch deep, and throw out potatoes that have a deep brown discoloration. (Fig. 66.) Cut out and discard decayed parts of the tuber.

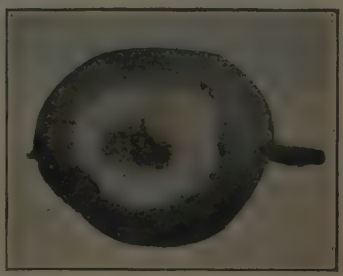

FIG. 66.—Potato stem end browning due to the wilt fungus. Unfit for planting.

EARLY BLIGHT.

Early blight appears about midseason as dark, dead spots on the leaves. (Fig. 67.)

TIPBURN.

Tipburn is a dying of the edges of potato leaves, from too much heat and lack of water. (Fig. 68.)

LATE-BLIGHT.

Late-blight (fig. 69) is the most serious disease of potatoes in the Northern States, since it is followed by rotting of the potatoes. (Fig. 70.)

For all these foliage diseases use Bordeaux mixture, adding arsenate of lead when potato beetles are present.

For late-blight August and September sprayings are most important. It has been found profitable, however, to spray at frequent intervals throughout the season, and thus protect the plants against grasshoppers, flea-beetles, and other insects, tipburn, and early and late blight.

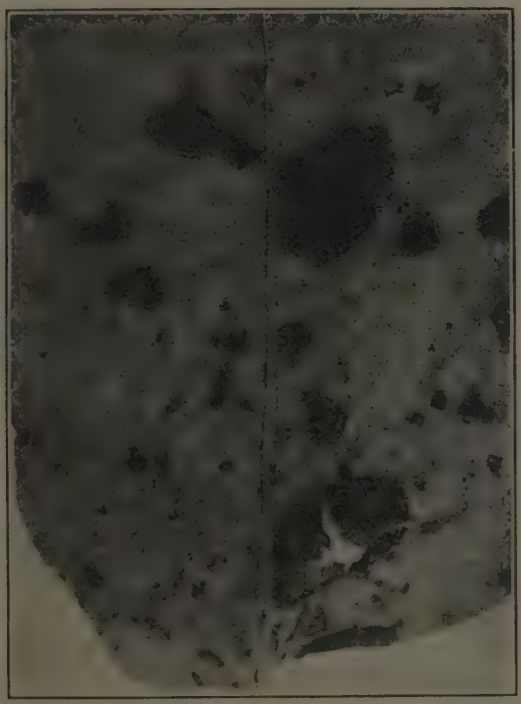

FIG. 67.—Potato early blight.

WEAK PLANTS.

Potatoes sometimes fail to grow vigorously, remaining small, with wrinkled or rolled leaves and bushy or spindling shoots. Several types of disease produce these effects, distinguished as leaf-roll, curly dwarf, mosaic, and spindling sprout. All are due to the planting of defective seed potatoes. From the gardener's standpoint no remedy exists and only one preventive—the securing of better seed next season. In the Central and Southern States northern-grown seed gives better results than the home grown, except when the latter is grown in the fall from northern seed.

STORAGE ROT.

Decay of potatoes after harvesting comes from two principal causes: (1) Late-blight dry-rot, resulting from failure to control the late-blight of the tops by spraying. Sort out all potatoes showing traces of dry-rot. (2) Wounds and bruises and too warm storage.

FIG. 68.—Potato tipburn.

FIG. 69.—Potato late-blight.

Potatoes should be handled with much care and kept in a cool, dark cellar.

RADISH.

Radishes are attacked by the same insects as cabbages. The cabbage worms, as a rule, do less damage, but the flea-beetles, especially the striped forms, sometimes are troublesome.

When radish is treated with lead arsenate for cabbage worms the flea-beetles will be destroyed. This spray is recommended against the western

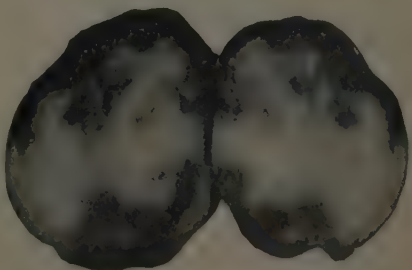

FIG. 70.—Potato late-blight tuber rot.

[1] *Phyllotreta pusilla* Horn.

radish flea-beetle[1] in its occurrence on young seedlings. Bordeaux mixture is good as a repellent or when sprayed in combination with arsenate of lead. Bordeaux mixture is discussed on pages 6 and 7.

ROOT-BLIGHT.

Radish root-blight causes dark and shrunken areas on the roots (fig. 71). It is due to a fungus occasionally encountered in gardens. Where this occurs radishes must be moved to a disease-free spot. Beets also are subject to attack by the same fungus.

FIG. 71.—Radish root-blight.

SQUASH.

Squashes, gourds, pumpkins, and similar crops suffer from the same pests as those which attack the cucumber.

WILT.

See cucumber wilt, page 46.

COMMON SQUASH BUG.

If the plants escape the striped cucumber beetle and the melon aphis they are apt to fall a prey to the squash bug (fig. 72), commonly known as the "stink bug," from its disagreeable odor. Like the melon aphis, it feeds by extracting the juices. A brood of these insects consisting of the adults and young, of which there are five stages, may destroy many plants in a short time.

Control.—Fortunately, the common squash bug is large enough to be seen easily. Hand picking before it lays its eggs is of value. Even the eggs, being in clusters, can be crushed or cut away from the leaves. A lookout should be kept for the bugs, beginning early in the season.

Some of the remedies advised for the striped cucumber beetle, such as protecting with covers and the use of nicotine sulphate, are helpful, but the adults are difficult to kill by contact poisons. The young readily succumb, especially when they are molting or shedding their skins.

The bugs may be trapped, also, by placing on the ground, at intervals near the plants, boards, shingles, or pieces of bark or similar material under which the insects can congregate for shelter. The traps should be examined and the bugs destroyed every morning during the early season.

SQUASH-VINE BORER.

After cucurbits have made good growth they sometimes are attacked by the squash-vine borer (fig. 73), which, however, is much more destructive to pumpkins and squash, especially Hubbard and marrow cymlings, than to other cucurbits. When these borers occur on cucumbers it is almost impossible to destroy them.

Control.—The following measures may be taken: Avoid planting in or near ground in which this species has occurred. Plant early

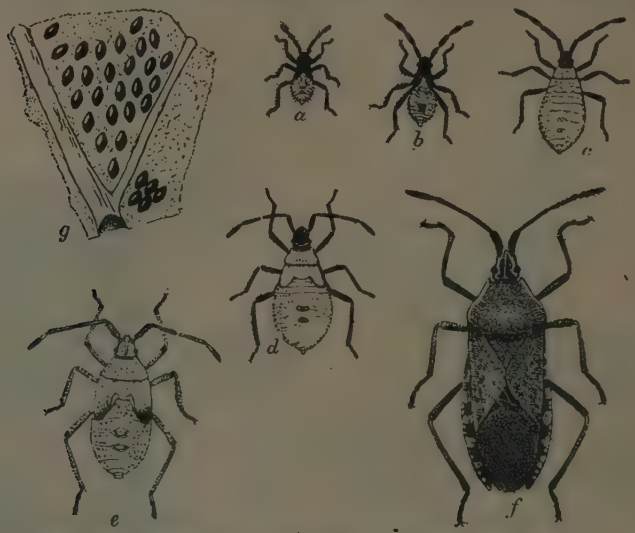

FIG. 72.—The common squash bug (*Anasa tristis*): *a*, Newly hatched nymph; *b*, second-stage nymph; *c*, third-stage nymph; *d*, fourth-stage nymph; *e*, fifth-stage nymph; *f*, adult; *g*, egg mass. All about twice natural size.

varieties of squash for a trap. Harrow the fields lightly in the fall, and plow deeply in the spring, to prevent the moths from issuing. Encourage the formation of secondary roots by covering infested stems with earth. Destroy dead vines and old plants as soon as the crop is made or whenever it becomes badly damaged. Keep plants in a vigorous condition, free from other insects and disease. Cut out borers if possible. Capture moths in sweep nets toward dark. Consult Farmers' Bulletin 668, "The Squash-Vine Borer."

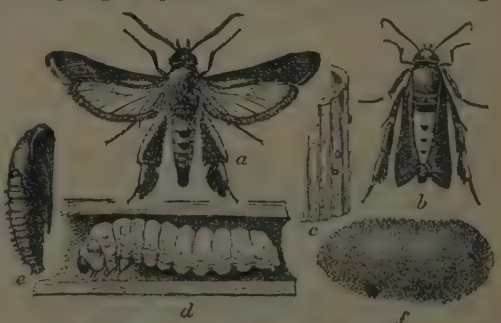

FIG. 73.—Squash-vine borer (*Melittia satyriniformis*): *a*, Male moth; *b*, female, with wings folded at rest; *c*, eggs shown on bit of squash stem; *d*, full-grown larva, *in situ* in vine; *e*, pupa; *f*, pupal cell. All one-third larger than natural size.

PICKLE AND MELON WORMS.

The pickle worm [1] and the melon worm [2] are pests in the southeastern portion of the United States and attack the fruit just before it ripens. It is practically impossible to control these insects without employing complicated measures. In small gardens paper bags may be pinned about the young fruit after it reaches the size of an egg. Since the caterpillar enters from without, the fruit is thus protected.

OTHER INSECTS.

The onion thrips, red spider, and greenhouse white fly are troublesome to cucumbers grown under glass. They can be destroyed by making smudges prepared by dipping papers into nicotine extracts. These are advertised in florists' journals.

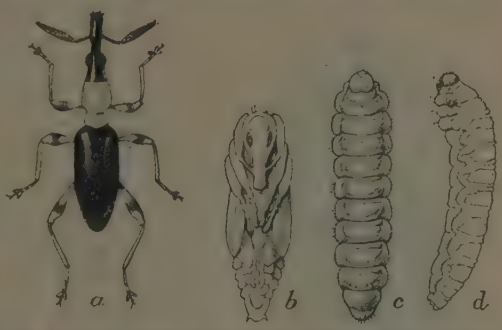

FIG. 74.—The sweet-potato weevil (*Cylas formicarius*): *a*, Beetle; *b*, pupa; *c*, larva, view of back; *d*, larva, side view. Much enlarged.

SWEET POTATO.

If transplanted from hotbeds the sweet potato may suffer from the attacks of cutworms and other caterpillars when first set out. Several other forms of insects attack the foliage, including blister beetles, the larvæ of sawflies, the sweet-potato flea-beetle, and the tortoise beetles. In its more northern range this crop does not suffer much loss from insect attack, but in Louisiana, Texas, and portions of Florida it is injured badly by the sweet-potato root-borer. Practically all of these insects mentioned as attacking the sweet potato breed on the morning-glory also and on other plants of this family, so that it is desirable to keep these down in the vicinity of the cultivated crop.

SWEET-POTATO WEEVIL.

The sweet-potato weevil or root-weevil (fig. 74) is confined to the Gulf region, but it has become one of our most injurious pests. The adult is a weevil with an antlike form and a decided snout or beak. It is about one-fourth of an inch long, including the snout; the wing covers are shining dark blue; the head and snout are darker blue; and the thorax and legs are dark red. The larva, or young, is grublike, about one-fourth of an inch long, whitish, with a brown head

[1] *Diaphania nitidalis* Cram. [2] *Diaphania hyalinata* L.

and darker mouth parts. The life history of this species can be passed in warm weather in about four or five weeks, and it is probable that at least four generations are produced in a year.

Control.—As the beetle practically confines itself to work on the tubers, only occasionally feeding on the foliage, the ripe tubers, as soon as found damaged, should be fumigated with carbon disulphid. (See Farmers' Bulletin 799.) Avoid curing and storage in high, moist temperatures. Badly damaged or imperfect tubers (see fig. 75) can be fed to hogs, and extremely bad ones should be burned in the field with the vines. *The utmost care should be exercised not to transport infested tubers to uninfested localities, or from an infested to an uninfested State.*

FIG. 75.—Sweet potato, showing injury by the sweet-potato weevil.

SWEET-POTATO FLEA-BEETLE.

The sweet-potato flea-beetle [1] does more harm northward. It eats out peculiar channels along the veins of both surfaces of the leaves soon after the plants are set out. Later the entire surface of the leaves becomes seared. This is the work of the beetles. The larva, or grub form, feeds at the roots of bindweed, of the sweet-potato family.

Control.—Before setting out the plants, dip them into arsenate of lead, about 1 pound to 10 gallons of water, and spray with lead arsenate a week or two later, after which a second spray may be necessary. Crop rotation also is desirable.

TORTOISE BEETLES.

Tortoise beetles of several kinds, some of them of brilliant hues, for example, the golden tortoise beetle (fig. 76) or "goldbug," rest or feed in broad daylight, when they can be captured and destroyed. When leaves are noticed to have holes in them, the beetles or their young are to be suspected. The larvæ, called "peddlers," can be picked off the lower surface of the leaves.

FALSEWORMS, OR SAWFLIES.

There are two species of sawflies, insects resembling small bees, whose young, or falseworms, injure sweet potatoes. (See fig. 77.)

[1] *Chætocnema confinis* Cr.

They have a rather wide range, but, as a general rule, are not destructive except locally. They may be controlled by spraying with lead arsenate when they first appear.

CUTWORMS.

Since sweet potato is cultivated in seed beds, cutworms do considerable injury. Remedies are considered on pages 14 to 16.

BLACK-ROT.

Black-rot may occur on any of the underground parts of the sweet-potato plant. On the tuber it is characterized by the dark to nearly black, somewhat sunken, more or less circular spots on the surface. Although the spots are small in the early stages, under favorable conditions they enlarge, involving nearly the whole tuber.

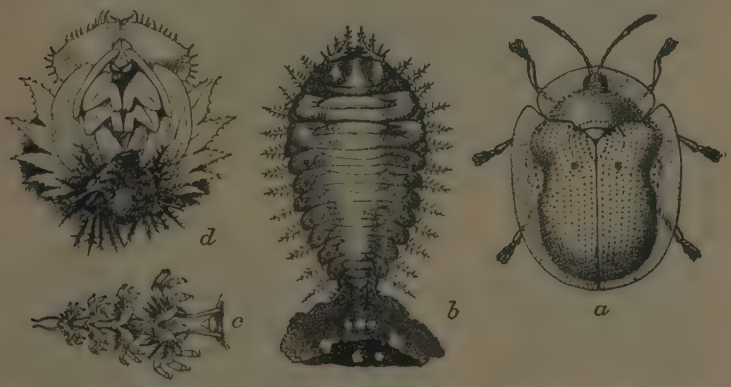

FIG. 76.—The golden tortoise beetle (*Coptocycla bicolor*): *a*, Beetle; *b*, larva; *c*, fæcifork; *d*, pupa. All enlarged.

The surface of the diseased spots has a somewhat metallic luster, and the tissue just beneath is greenish. In storage the disease spreads from one potato to another.

On the stem the infection begins as a small black spot, which enlarges gradually until the whole of the stem is rotted off. Sometimes the infected areas extend from the potato to the surface of the soil. Figure 4, page 7, shows the characteristic symptoms of this disease on a young slip. Black-rot occurs in the hotbed and in the field. It may come from the use of infected soil or from the use of infected potatoes for seed. In the latter case the fungus grows from the potato to the slips and is carried on the slips to the field. Diseased slips generally die in a few weeks in the field.

Control.—The home gardener, in buying sweet-potato plants, should make sure that they are sound and healthy. Those who grow

plants for larger fields should procure Farmers' Bulletin 714, which gives directions for growing healthy plants in seed beds.

STEM-ROT.

When sweet-potato plants are affected with stem-rot, the leaves turn a dull yellow and become somewhat puckered, then wilt and die, beginning at the tip of the vine. The inner wood of the vine is blackened.

Rotate crops; secure healthy plants.

FIG. 77.—The smaller sweet-potato sawfly (*Schizocerus ebenus*): *a*, *b*, Larva; *c*, *d*, segments of larva showing spines; *e*, eggs deposited under leaf; ♂, male sawfly; ♀, antenna of female sawfly. All much enlarged; *c*, *d*, greatly enlarged.

FOOT-ROT.

Foot-rot causes small black or brown spots on the stem near the soil, which enlarge until the plant is girdled and the vine wilts and dies.

Control.—The disease is carried from the hotbed by young plants. The remedy, therefore, is to set out only plants that are healthy.

STORAGE ROT.

Decay of sweet potatoes in storage may be traced to one of the foregoing diseases or to soft-rot. This is due to wounds or bruises or

to improper storage conditions. Keep sweet potatoes in a moderately cool and dry place after digging. See Farmers' Bulletin 714.

TOMATO.

The insects which attack the potato and the eggplant injure the tomato to a less extent, and tomatoes suffer greatly from other pests.

TOMATO HORNWORMS.

The tomato hornworms [1] (fig. 78) are large green worms, sometimes called tomato worms or tobacco worms, as they feed about equally well on both plants. They are the larvæ, or young, of large sphinx

FIG. 78.—One of the tomato hornworms (*Phlegethontius sexta*): *a*, Adult moth; *b*, larva; *c*, pupa. (Howard.)

moths of two species, which are very similar in habits and distribution. These insects produce two broods, and when they begin to mature they cut all the leaves from tomato plants. Growers should be on the lookout for the first as well as the second brood They appear at various times, according to the locality.

Control.—Hand picking can be practiced, but it takes an experienced eye to detect these worms when they are at rest. When feeding they are more easily seen and can be destroyed readily. A

[1] *Phlegethontius quinquemaculata* Haw. and *P. sexta* Joh.

single application of lead arsenate at the usual rate will destroy them even though crudely applied. Those which eat the poison first will be found dead the following day. The remainder will be found on the second or third day.

FIG. 79.—The tomato fruitworm, bollworm, or corn earworm (*Chloridea obsoleta*): *a*, Moth, or adult; *b*, larva. About natural size. (Howard.)

TOMATO FRUITWORM.

The tomato fruitworm (fig. 79) is the same insect as the bollworm of cotton and the corn earworm and is the cause of much trouble to tomato growers because of its eating into the ripening fruit (fig. 80) and destroying its market value.

Control.—Lead arsenate, 2 pounds to 25 gallons of water, applied two or three times, will keep the insect under partial control. As long as sweet corn is growing in the vicinity it attracts the worms, leaving the tomatoes less subject to attack. Hand picking is too difficult.

FIG. 80.—Characteristic work of the tomato fruitworm. (Quaintance and Brues.)

CUTWORMS.

Various cutworms attack the tomato when it is set out. Indeed, it is the favorite food plant of most forms of cutworms. For control, see pages 14 to 16.

FLEA-BEETLES.

The potato flea-beetle[1] frequently attacks tomatoes and does considerable damage.

Control.—Dipping young plants in lead-arsenate solution at the rate of 1 pound to 50 gallons of water, before setting out, will protect them considerably against injury.

Bordeaux mixture also acts as a deterrent. (See p. 6.)

[1] *Epitrix cucumeris* Harr.

LATE-BLIGHT.

A rapid blighting of the leaves, accompanied by rotting of the fruit, is due to the same fungus as that causing potato late-blight. This is common in the Appalachian region.

It is controlled by spraying with Bordeaux mixture as advised for leaf-spot.

LEAF-SPOT.

In leaf-spot, the leaves are covered with dark-brown spots (fig. 81) and shrivel and die, beginning at the base of the plant. This is the worst disease of the tomato. Spray with Bordeaux mixture and resin fish-oil soap before the disease appears and repeat at 10-day intervals. Try to spray the lower side of the leaves as well as the upper side.

FIG. 81.—Tomato leaf-spot.

MOSAIC DISEASE.

Mosaic disease crumples and distorts the leaves and produces irregular, light-green areas. The plants are weak and unfruitful. In the "fern-leaf" type the leaves become very narrow.

Mosaic disease is communicable from plant to plant by insects, especially plant-lice, and by contact. When it appears in gardens it is best to destroy the affected plants and set out others.

BLOSSOM-END ROT.

A decay of the fruit at the blossom end (fig. 82), though not understood clearly, appears to be connected with soil conditions, particularly with the water supply. To prevent it, try to make the soil well drained but retentive of moisture. Water the plants if needed. Plant the variety Bonny Best, which seems to resist blossom-end rot. Tomatoes trained to stakes and pruned often are less attacked.

WILT.

Wilt causes the plants to wilt and die suddenly. It is especially prevalent in the South, where three different forms of wilt are found. Destroy diseased plants. Use new land for the next planting.

FIG. 82.—Tomato blossom-end rot.

TURNIP.

Turnips are attacked by the same insects as cabbages. (See pp. 31 to 38.)

CLUBROOT.

Clubroot of the turnip causes swollen, distorted roots similar to those caused by cabbage clubroot, which see (p. 39 and fig. 3, p. 6). Rotation and lime are advised, as for the cabbage.

WATERMELON.

Watermelons are affected by insects considered under "Cucumber" (p. 43), and great injury is done by the melon aphis (p. 45). For the control of watermelon pests, see under "Cucumber" and procure Farmers' Bulletin 821.

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